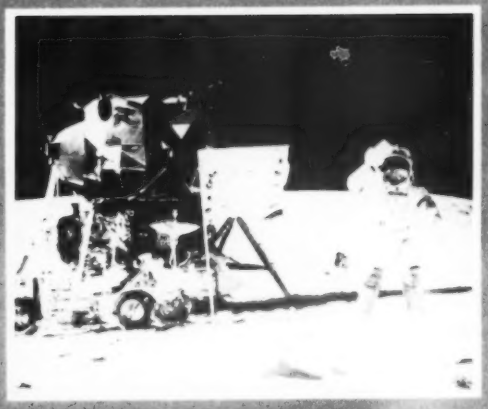

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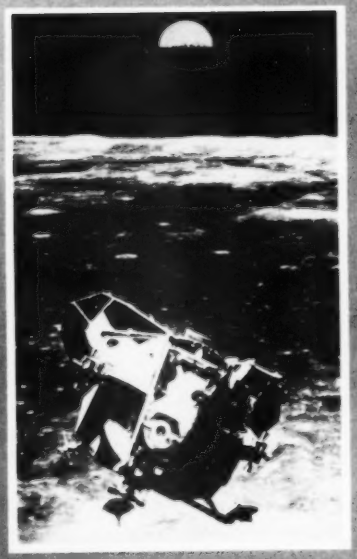

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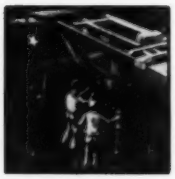

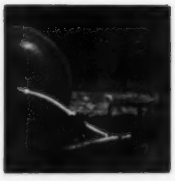

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BG James M. Leslie

EDITOR, U. S. ARMY AVIATION DIGEST
Richard K. Tierney

ABOUT THE COVER

A recognized authority in the field of system safety talks about NASA's way of getting the job done safely. See page 4

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine and other related data.

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Articles, photos, and items of interest on Army aviation are invited. Direct communication is authorized to: Editor, U. S. Army Aviation Digest, Fort Rucker, Al. 36360.

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VIEWS FROM READERS

Sir:

Major Phil Branstuder's letter (March 74) and the response from Colonel McMahon, Office of the Chief of Military History, are good examples of the difference between the real world and officialdom. In the real world the UTT, 68th, 197th and 334th most assuredly have a common lineage and by no stretch of the imagination can it be said that the 68th, 197th and 334th are "separate and unrelated organizations with different histories."

Using the dates listed in COL McMahon's response, I will attempt to outline the chronology as it really happened in Southeast Asia:

• UTT was formed on Okinawa, moved to Thailand, moved to Vietnam and inactivated on 14 August 1964 in Saigon, Vietnam.

• The 68th (Armed) activated on 15 August 1964 in Saigon, Vietnam, with the same personnel, same aircraft, same equipment, same location, same mission as UTT, but new patch. The 68th (Armed) inactivated in Saigon, 1 March 1965. The 68th (Slick) activated at Ft. Benning, 5 July 1965, and sent to Vung Tau, Vietnam, where the unit was assigned to the 145th Aviation Battalion—the same battalion that the 68th (Armed) had been assigned to. The 68th (Slick), like so many other aviation units formed during the 1965-66 build-up phase, had so many field grade officers assigned that some wag altered their unit sign at Vung Tau to read "Every man a tiger—and every other man a Major!" The 68th (Slick) participated daily in combat operations supported by the 197th (Armed) which had replaced the 68th (Armed).

• The 197th (Armed) was activated on 1 March 1965 in Saigon with *all* of the people, *all* of the equipment at the same location with the same mission in the same battalion as the 68th (Armed). The 197th (Armed) was deactivated on 1 September 1966 and *only* the number was transferred to Ft. Benning—*all* of the people, *all* of the equipment remained in the same location with the same mission in the same battalion.

• The 334th (Armed) was activated on 10 November 1966 at Bien Hoa and the entire complement of personnel and equipment from the 197th (Armed) was either AWOL or nonexistent from 1 September 1966 until 10 November 1966. However, they continued to carry out their old mission.

As for the Institute of Heraldry's not having any record of an authorized pocket patch for the 68th (Armed), 197th (Armed) and 334th (Armed), it is simply because no one ever bothered to ask them for approval. The companies and the three platoons all had their own pocket patches and crests authorized by the company commanders and produced by Tailors World Wide, 95 Hai Bai Trung, Saigon, who incidentally was the only one to profit from this seemingly endless number-changing game. You can change the numbers but the game stays the same as evidenced by the fact that all radio callsign changes were also ignored by the UTT, 68th and 197th. The troops on the ground had little faith in "new" numbers or new callsigns. To them, for many years *all* armed helicopters were "UTTs." So much for semantics and numerology.

LTC Bill Fraker
(Formerly Playboy 16, Raider 26, and Sabre 3)
TRADOC
Ft. Monroe, VA 23651

Sir:

After reading Brigadier General Merryman's answer to Captain Smithwick's letter (March 1974 DIGEST), I must say that I have never seen the reasons for commissioned pilots maintaining branch proficiency outlined so clearly. As an aviator with previous branch experience prior to being rated, I have tried to explain to other commissioned aviators with Captain Smithwick's views why they should (and must) maintain branch proficiency. General Merryman's letter summed it up.

However, I do take exception to the General's referral to aviation as "just an additional skill. . . ." I daresay that, in terms of maintaining skill level and knowledge of the craft itself, aviation (unless the officer is merely a badge-hunter) comes closest of all other military qualifications to requiring creation of a separate branch (or at least designation as a secondary career field) in order to maintain a group of highly qualified commissioned aviators in the Army.

CPT Michael P. Weller
Co C 227th Avn Bn
1st Cavalry Division
Ft. Hood, TX 76545

• General Merryman wrote the following response while he was Director of Army Aviation:

Dear Michael:

Your letter of 28 March 1974 to the Editor, U. S. ARMY AVIATION DIGEST, has been referred to my office for reply. I have elected personally to respond because I appreciate your views.

Michael, as an Army aviator who had accumulated previous infantry

Continued on page 27

AIRMOBILITY

General Tarplay exploits the mid-intensity battlefield relating that the demonstrated capabilities of Army aircraft to the Infantry commander far exceed their vulnerabilities

in mid-intensity warfare

Major General Thomas M. Tarpley
Commandant, U. S. Army Infantry School

ON 15 FEBRUARY 1963 cadres to organize, train and test the 11th Air Assault Division (T) and the 10th Air Transport Brigade were activated at Ft. Benning, GA. These test units were one of the major recommendations of the now famous Howze Board [U. S. Army Tactical Mobility Requirements Board chaired by General Hamilton H. Howze in 1962]. In the years that have passed since that historic beginning, airmobility has come of age and earned the respect of friend and foe through yeoman service in the Republic of Vietnam.

The application of the airmobile concept in the low-intensity environment of Vietnam surpassed our expectations, but the full potential has yet to be exploited. We must now look to the future and develop tactics and techniques for the employment of our airmobile assets in areas other than South Vietnam. In this article I plan to touch briefly on the views of the U. S. Army Infantry School concerning airmobility in future mid-intensity warfare.

Just what is meant by a mid-intensity conflict? The term means different things to different people, depending on one's perspective. Key features of the Army's definition of mid-intensity warfare are shown in figure 1.

In developing concepts for mid-intensity conflict, we consider potential threat forces in Europe, the Mideast and other regions. In addition to the threat to the Infantryman and his supporting weapons, we are very much concerned with the threat to our helicopters. Results of operations against the North Vietnamese air defense weapons in the later phases of the Vietnam conflict and the emerging results of the 1973 Arab-Israeli conflict will certainly affect the tactics and techniques of future helicopter employment.

To overcome a massive armor threat, Infantry units must capitalize on mobility and firepower. Specifically, we must combine the advantages of airmobility, aerial fire systems and our new Infantry antitank weapons systems.

The survivability of Army aircraft in a mid-intensity environment is a question that can only be answered by determining aircraft susceptibility to hostile weapons systems and the capabilities of the enemy's soldiers to employ them. We know threat forces can create an effective air defense umbrella above their ground forces. However, this does not negate the contribution airmobility can make

to the mid-intensity battlefield.

Our experience in Vietnam and field experiments addressing the future role of helicopters indicate the survivability of our aerial assets can be enhanced considerably. Proper employment techniques, dispersion, neutralization of enemy air defense systems and hardening of the aircraft are proven means of improving survivability. During the North Vietnam Army spring offensive of 1972 and Operation LAMSON 719, we were confronted with an effective air defense umbrella. While the air defense threat we faced during these operations does not equate to that which we expect to encounter on the mid-intensity battlefield, we have learned that survivability of the helicopter is enhanced by employing nap-of-the-earth (NOE) flying techniques, by frequently changing flight headings and by avoiding overflight of known or suspected enemy air defense sites or by suppressing these sites.

We firmly believe the vulnerability of any system must be considered in relation to its contribution to the destruction of the enemy and it must be compared to the vulnerability of other means of accomplishing the same mission. In studies and experiments where this comparison has been attempted, the demonstrated capabilities of Army aircraft far exceed their vulnerabilities.

In our efforts to develop airmobile concepts for the mid-intensity battlefield, we are convinced that Infantry units must exploit the reconnaissance and surveillance capabilities of aerial systems. Infantry units must be supported by an aerial reconnaissance system which provides the commander with firsthand intelligence. We look forward to the advanced scout helicopter (ASH) to assist in the aerial reconnaissance role.

In offensive operations we visualize airmobile forces operating hand-in-hand with mechanized elements.

An airmobile capability will permit commanders to exploit the fleeting opportunities which present themselves during fast-moving operations. The river crossing depicted in figure 2 will be typical of combined operations employing airmobile and mechanized forces which could be expected on the mid-intensity battlefield.

In a hasty river crossing airmobile units would seize crossing sites before the enemy could effectively defend them. These units would hold the sites until linkup by ground elements. For a deliberate river crossing an airmobile force could conduct a vertical envelopment to landing zones behind the enemy's river line defenses and then attack his positions from the rear while our ground elements force a crossing. A critical factor in conducting such operations will be the suppression of enemy air defenses by our supporting artillery and other weapons systems, as well as by electronic countermeasures.

We also envision extensive use of airmobility during defensive operations. Lift assets will enable commanders to reposition forces rapidly to block unexpected enemy thrusts on the fluid battlefield. We will be able to conduct spoiling attacks against his flanks and rear. Helicopters will also enable rapid commitment of reserves and will in-

Continued on page 29

Mid-Intensity Conflict

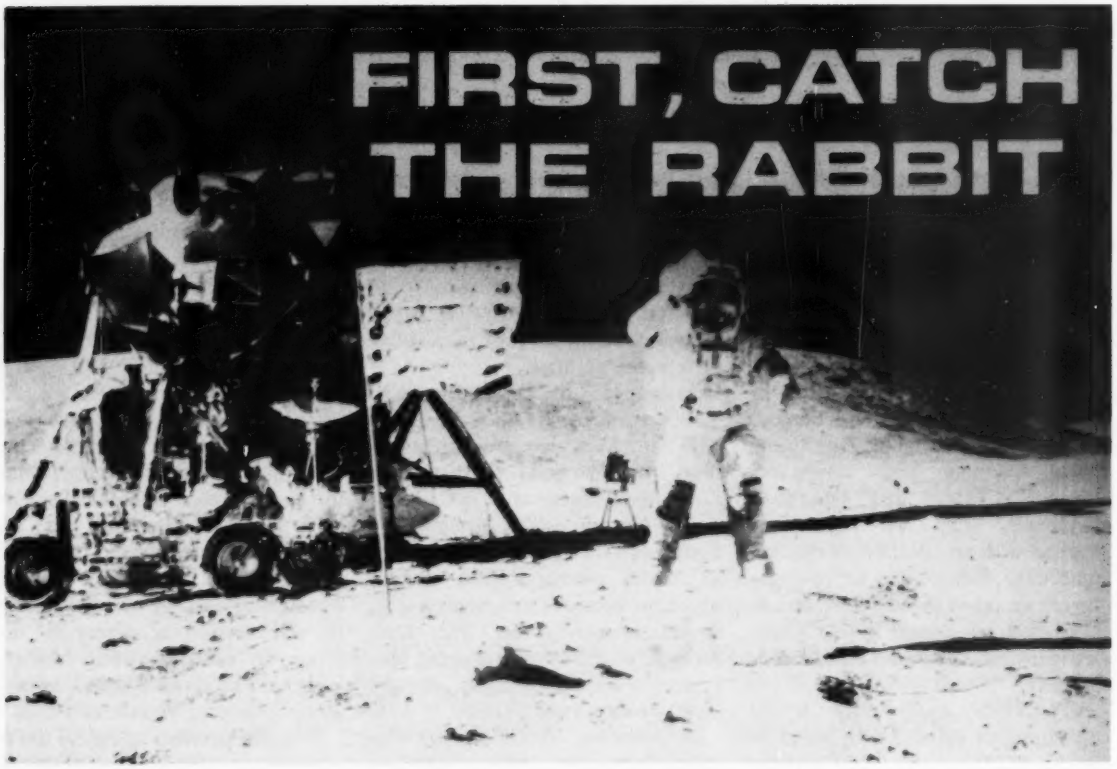
- **Nonnuclear**
- **National policy limitations**
- **Sophisticated environment**
- **Large armored forces**
- **Rapidly changing battlefield conditions**

Figure 1: The Army's definition of a mid-intensity conflict is outlined at right

USAAAVS

an interview with Dr. Leslie W. Ball, Director of Safety at NASA's George C. Marshall Space Flight Center, who talks about ways and means to get a job done safely—the highest challenge of the commander's skills

FIRST, CATCH THE RABBIT



Achievement of safety is an undelegatable responsibility of any military commander and any civilian organization director. What is delegatable to a safety staff is first, the responsibility for preparing all the policies, directives and procedures through which the commander's or director's authority is used to require elimination of unsafe conditions and unsafe acts; and second, surveillance over, and analysis of, product development, maintenance and operations to the extent necessary to provide the commander or director with the data which he needs either to be assured that hazards have been eliminated or to face the responsibility for acceptance of residual hazards that cannot be eliminated within cost, schedule or technical constraints.

Rocco A. Petrone
Director
George C. Marshall Space Flight Center

COL F. M. McCullar, Commander, U. S. Army Agency For Aviation Safety:
I selected Dr. Ball for interview because of his most unusual combination of education, personal research and safety and industrial management experience. His experience has ranged from guiding the development of high reliability components to playing a significant role in the systems engineering of aircraft, missiles and rockets.

His education in physics research at Manchester University in England, with the Nobel prizewinner Sir Lawrence Bragg, developed the analytical ability which he has successfully applied to identifying safety hazards in the development of military, commercial and space products. This wide range of both technical and management experience has made Dr. Ball a recognized authority in the field of system safety management.

McCullar: I'd like to start, Dr. Ball, with your definition of system safety.

Ball: System safety is an analytical technology. Its purpose is to assure systematic hazard identification, then to provide criteria for a designer to control each identified hazard. The old recipe for rabbit stew applies to system safety—first, catch the rabbit. If you don't first identify the hazard, you're in no position to engineer it out of the system. Hazard identification comes first. Then you put the designer to work and say to him, "Now do everything you can to control that hazard." After the designer has done his work, system safety must include systematic evaluation of the degree to which each hazard is being controlled and then it involves presenting to management—the manager or the commander who must accept responsibility—an assessment of the hazards involved. That's where management gets into the act because, in most cases, there's a residual hazard. It's very rarely you eliminate the hazards altogether. Take the gasoline tank on your car. You know it's a hazard. It's equivalent in explosive power to hundreds of sticks of dynamite. But you can't very well get rid of the gas tank.

Management responsibility for accepting the degree of hazard control is a very real thing. Dr. George Low, who is the deputy administrator of the National Aeronautics and Space Administration (NASA), was reminiscing recently at a NASA Safety, Reliability, Quality Director's meeting and looking at the accidents NASA has had, such as the loss of the Apollo 204 astronauts and the problems of Apollo 13 where we had to abort the mission. He said, whenever we have identified a hazard, we have done magnificently in controlling it. But every so often, and his words were, "Nobody asks the right question; for example, nobody asks what if the aerodynamic pressure gets under the Skylab meteroid shield." Today, in system safety, the weakest link is the first step, identification of the hazards. Repeating again the recipe for rabbit stew, first catch the rabbit.

McCullar: Sometimes it takes a catastrophic accident to get safety the attention it deserves. I understand the Apollo spacecraft fire on the pad at Cape Kennedy in 1967 where three astronauts lost their lives was

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Dr. Leslie W. Ball is Director, Safety and Manned Flight Awareness Office, at NASA's George C. Marshall Space Flight Center near Huntsville, AL.

Born in Winnipeg, Canada, Dr. Ball attended high school in Buxton, England. He earned a BSc (Hons), MSc and MSc technical degrees at Manchester University, Manchester, England, and was awarded DSc degree by Pacific States University in California.

Dr. Ball began work on improving manufacturing processes and quality control and reliability techniques in 1938 at the Canadian National Research Laboratory, Ottawa, Canada. He served as research director with the Naval Ordnance Laboratory, Silver Spring, MD, in 1946, and later accepted the position of Vice President Technical Director of Wyle Laboratories, El Segundo, CA, and Vice President General Manager of Stelladyne Laboratories, El Cajon, CA. Prior to becoming a member of the Marshall Center team in 1970, he was employed for 10 years by The Boeing Company, Seattle, WA, as the Aerospace Group Director of Product Assurance.

Dr. Ball has published 150 papers in the fields of metallurgy, physics, nondestructive testing, reliability, quality control, system engineering and system management. These publications include papers in English, German, French, Russian, Polish, Dutch, Norwegian and Japanese. He is a Fellow of the American Society for Quality Control and has been chairman of the ASQC Reliability Division. He also has been national president of the American Society for Nondestructive Testing. He has received two national technical achievement awards and several international honors.

Artist's concept of the employment of the general support rocket system

COUNTERFLAK

Major General David E. Ott
Commandant, U. S. Army Field Artillery School

The Field Artillery has recognized and has been engaged in providing counterflak fire support since the first time that a Confederate rifleman attempted to shoot down Professor Thaddeus S. C. Lowe and his balloon during one of the first recorded tactical employment of aerial vehicles

CURRENT ARMY DOCTRINE states that requests for, and coordination of, counterflak fires are processed through fire support channels and are implemented at the artillery fire direction center upon the request of forward air controllers (FACs), fire support officers or other personnel as necessary. In essence, the Field Artillery is primarily responsible for the provision of the counterflak means for the Army and the coordination required for incorporation of other service antiair suppressive capabilities.

Long term but recently intensified use of aircraft to transport and resupply ground troops and to tactically support them with firepower has stimulated our potential enemies to vastly improve their antiaircraft systems. It is evident that the air defense threat likely in a mid-intensity environment is formidable. The recent Middle East war has accentuated the fact that a sophisticated air defense capability exists which is characterized by an integrated command and control system capable of coordinating the fires of antiaircraft artillery, surface-to-air missiles and air-to-air missiles. Moreover, coordination embraces the maneuver scheme. It also is evident that the doctrine of potential

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TACTICS outlook

. . . Army Aircraft Maintenance

Major General Jack C. Fuson
Commandant, U. S. Army Transportation School

This is the second of three articles by General Fuson on the role of the Transportation Corps and its impact on the future of Army aviation

WITH THE CESSATION of hostilities in the Republic of Vietnam, the Army is now evaluating its performance to see where opportunities may exist to make improvements in the way the forces in the field operate. An area now under scrutiny is the maintenance of Army aircraft. New concepts affecting the maintenance structure are being developed and this is having a direct impact upon the U. S. Army Transportation School at Ft. Eustis, VA.

As a result of the 1973 reorganization of the Army the responsibility for development of maintenance doctrine for Army aircraft was assigned to the Transportation School. In support of this mission, the School is now involved in studies, preparing field manuals, evaluating and revising tables of organization and equipment (TOE), and identifying materiel requirements related to aircraft maintenance. Actually, the School first became involved in the aircraft maintenance business in 1952 and provided the doctrinal guidance until around the latter part of 1965, when the mission was transferred to the now deactivated Combat Developments Command Maintenance Agency.

Although during the following 8 years the Transportation School had no direct role in doctrinal preparation, it nevertheless remained active in the program by training aircraft maintenance personnel and staffing aircraft maintenance units that were located worldwide. This enabled the School to remain closely associated with the program. The current activity in exploring new concepts related to aircraft maintenance is providing the Transportation School with the opportunity of using its experience in the development of a more efficient system to maintain Army aircraft.

This article concentrates on those concepts under development that are aimed at providing the Army in the field with an aircraft maintenance structure capable of efficiently operating under varied combat conditions.

While experience in Vietnam has influenced the concepts being developed, it should be kept in mind that Vietnam experience

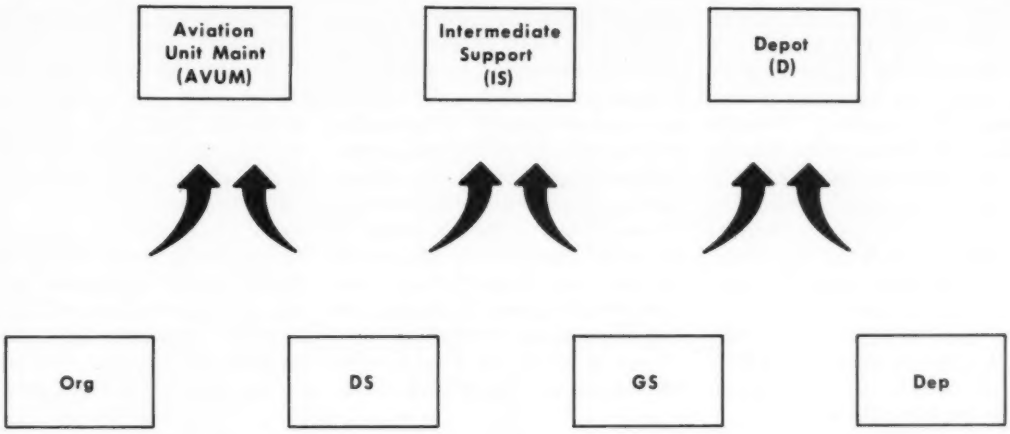


Figure 1 - Proposed Three Level Aircraft Maintenance Concept

alone is not the sole reason for the changes being made. The influence of concepts of operation that envision highly mobile forces maneuvering rapidly over broad areas and the development of highly sophisticated helicopter sytems with specialized armament and avionic equipment need to be considered. Also, recognizing that we are in an austerity period where every dollar must be stretched requires that we take a look at what we now have available to maintain Army aircraft and see how we can improve upon this capability.

In order to obtain a better appreciation of the changes being proposed, it is necessary to briefly mention the maintenance system under which we have been operating. Aircraft maintenance, as most of you are aware, has been provided to the field through a structure composed of four basic categories of maintenance: organizational, direct support (DS), general support (GS) and depot. This system is geared toward the removal and repair of unserviceable parts. Under the present system aviation units perform organizational maintenance and receive direct support from aircraft DS maintenance companies. Some aviation units, when the density of assigned aircraft dictates it, have a DS capability added on a fulltime basis. There are both divisional and nondivisional DS aircraft maintenance companies authorized to the Army in the field and these units support the user by what is colloquially referred to as a return-to-user maintenance system. Providing backup support in the system are the nondivisional aircraft maintenance GS companies. At the far end of the system, providing an overhaul/rebuild capability, are the Army Materiel Command (AMC) depots.

One of the first areas in the current system to come under study was organizational maintenance, specifically in those aviation units that were authorized more than 10 aircraft. In the 1950s when the Army formed its first helicopter companies, it was recognized that the assignment of a sizable number of helicopters to one unit presented some unique maintenance problems that could not be handled through the normal organizational maintenance capability. Therefore, the first light cargo helicopter companies, which through evolution materialized into our current airmobile companies, had a DS team attached. This team became known as the "KD" team, the designation applying to its identification in a cellular TOE. Through experience gained in Vietnam, when numerous airmobile companies were employed, it was decided that it was more advantageous to make the DS capability provided by the KD teams an integral part of the company organization. The teams were "absorbed into" the airmobile companies and now each of these units has an organic DS capability as part of the company. Today, we refer to the integration of the DS capability into certain aviation units as integrated direct support maintenance (IDSM). AR 750-1 authorizes IDSM in aviation units usually having a density of more than 10 aircraft, with exception being made for selected units such as a CH-54 company which has nine Flying Cranes assigned.

The maintenance services provided Army aircraft at the DS and

GS levels were the next areas to be evaluated. The employment of thousands of helicopters in Vietnam, with the resultant heavy maintenance workload, revealed certain deficiencies in the DS/GS aircraft maintenance concept. This subject was examined in detail by the U. S. Army Logistics Evaluation Agency (LEA), as documented in a study entitled "Army Aircraft Maintenance Support." A key recommendation in the study proposes the amalgamation of DS and GS aircraft maintenance into a single level or intermediate support level. Perhaps the greatest indictment in the study against retaining the present DS/GS aircraft maintenance system is that, under conditions encountered in Vietnam, it produced an uneconomical and an out-of-balance use of resources at the two categories in such areas as repair parts, facilities, special equipment and personnel. Two things had much to do in bringing this situation about. First, there was the common usage of IDSM. Recall now that IDSM provides the aviation units with the capability of accomplishing limited DS maintenance. Accumulated data indicate that as much as 80 percent of all DS maintenance was accomplished at the unit level. Second, for various reasons, the lack of a field capability to accomplish GS maintenance as envisioned in the original concepts and maintenance allocation charts (MACs) on the sophisticated helicopters being employed necessitated considerable retrograde to the continental United States (CONUS) of components and engines for repair and overhaul. An evaluation of GS aviation maintenance indicates that only about 20 to 25 percent of that kind of work was accomplished by GS aviation maintenance units, the remainder being evacuated to depots.

As a result of the Vietnam experience, the Army is now turning to a three-level maintenance concept for Army aircraft. The accompanying chart shows how the three-level concept will provide maintenance support previously obtained through the four categories of maintenance. Broadly stated, the aviation unit maintenance (AVUM) level includes the current aircraft maintenance functions authorized in appropriate MACs for organizational maintenance in addition to those functions assigned to the IDSM level. Intermediate support (IS) includes the balance of DS plus those GS functions listed in the MAC that do not require time-consuming, complicated or sophisticated equipment in order to make repair. Depot level will include those functions already assigned to that category plus those time-consuming and complicated functions previously accomplished at GS level. As a point of interest, the Army already is beginning to implement the three-level concept and project managers of three new developmental aircraft systems—utility tactical transport aircraft system (UTTAS), heavy lift helicopter (HLH) and advanced attack helicopter (AAH)—are planning the logistical support for these aircraft in accordance with the proposed system.

In line with its doctrinal responsibilities, the Transportation School is now engaged in developing an organizational structure to support the three-level aircraft maintenance concept.

The design of this structure complements those logistical concepts envisioned as being necessary in order for the Army to attain a high degree of operational capability from the sophisticated helicopter systems now being developed.

First, the proposed structure emphasizes the maintenance philosophy of remove and replace instead of remove and repair. The next generation of Army helicopters is being engineered so that most malfunctions will be corrected through modular or component replacement. Component repairs in a theater of operations will be limited to those necessary to support the direct exchange (DX) program.

Second, with the C-5A and other large cargo aircraft in the U. S. Air Force inventory, considerable reliance will be made on logistical support through an air line of communications. Components and repair parts will move into the theater of operations by air while unserviceables will be retrograded in a similar manner.

Third, every effort will be made to lessen the logistical responsibilities of the using units in order to improve their operational effectiveness. As part of this effort, the intermediate support level units will be the only aircraft maintenance units in a theater with an authorized

stockage list (ASL) responsibility. Additionally, supply distribution will change from unit pickup at supply points to unit delivery. This will require the supply platoon of the IS level unit to transport repair parts to its customers.

At the AVUM level, a requirement exists to evaluate the availability of DS maintenance for those aviation units not authorized IDSM. For division aviation units consideration is being given to structuring an aircraft maintenance company that will provide DS maintenance support of those aviation units not authorized IDSM and also have the capability to provide backup support to the IDSM units.

At the IS level it is envisioned that a proposed unit will operate from semi-fixed facilities but will possess a capability to dispatch mobile contact teams to supported units. The IS unit will provide the interface between the AVUM units and the depots. Briefly stated, its assigned functions will include repair of end items and designated modules/components requiring limited special tools and/or test equipment. It will be responsible to troubleshoot, adjust, align and calibrate in accordance with the MACs. It will operate a DX service and perform recovery and evacuation of aircraft. It will also provide the supply support previously explained in this article. Under the three-level concept depots will basically operate as they have been and will continue to provide repair and overhaul service.

One other proposed organization which the Transportation School is developing, based upon a requirement that surfaced in Vietnam, is for an aircraft assembly and retrograde team. The function of this unit would be to assemble and test fly all new aircraft arriving in a theater from CONUS, and to clean, package and prepare for retrograde all aircraft returning to a CONUS depot. The team probably would be located at an air terminal capable of accepting large cargo-type aircraft. The reason for this team is that currently personnel from a nondivisional DS or GS unit must be removed from their aircraft or component repair tasks in order to accomplish these aircraft assembly and retrograde functions.

Simultaneously with the developmental efforts described above, the Transportation School currently is engaged in a study effort to determine the adequacy of the Army in the field maintenance structure to perform aircraft maintenance at night in mid-intensity conflict environments. You might say at this time, "So, what's new? We accomplished night maintenance on Army aircraft in Vietnam." Vietnam gave us certain allowances on which we always cannot depend. Our units were able to work in well lighted areas, sometimes in fixed facilities, without the threat of enemy aircraft. The idea of a night maintenance study, known by the acronym CONAM, is to see how we can do the job under varied tactical situations where we may not have all the tactical advantages on our side and to try and identify what type of equipment the maintenance personnel will need. We generally agree that night maintenance on Army aircraft is with us, now the question is: How can we best accomplish it in something other than a low-intensity environment?

Finally, and right in line with the study efforts mentioned, the School is deeply involved in identifying and developing those materiel items needed to make these new concepts work. An example is the work now being done in a shelter program. Obviously, whatever is designed must be compatible with operations in the field, must be mobile, must be easy to erect and take down, and must be reliable. The Transportation School also is evaluating the pros and cons of using standard size containers in some units as replacements for truck mounted shop vans. These are but a few of the materiel efforts now underway in support of our proposed aircraft maintenance structure.

Naturally, like any conceptual or developmental effort, there is no guarantee that everything now being worked on will materialize as part of the Army of the future. However, the developmental actions cited above appear to be "flying" in the right direction and show promise of having the Army aircraft maintenance structure ready and compatible with the entry of the new complex and exotic aircraft systems that are programed for the Army in the field.

Air-To-Air Combat For Helicopters

Illustrations for this article were provided by the U. S. Army Combat Arms Training Board, Ft. Benning, GA, from the test edition of Training Circular 17-37-1, "Training the Air

Harvey F. Jossen, DAC

Training Developments Department

Deputy for Developments

U. S. Army Aviation Center

CURRENT TECHNOLOGY makes it entirely feasible that the Warsaw Pact nations have developed an armed helicopter. The long expected possibility of armed helicopters engaging each other would thus be a high likelihood. Now is the time for a serious reassessment of the U. S. Army's conventional concepts of helicopter employment in a high air defense threat environment.

In the light of present threat capabilities the war in the Republic of Vietnam is truly ancient history, speaking air-to-air only. Army aviation's combat experience in Vietnam affords little or no data or expertise upon which to build air-to-air helicopter tactics; however, the attack helicopter, with its flexible weapons, is certainly a logical helicopter killer.

Because of the nature of its facilities and training operations, the U. S. Army Aviation Center at Ft. Rucker, AL, has a wealthy concentration of rotary wing flight expertise that is essential to experimental development of air-to-air combat for helicopters. Logically, then, why not use Ft. Rucker as the principal center for this most necessary developmental program?

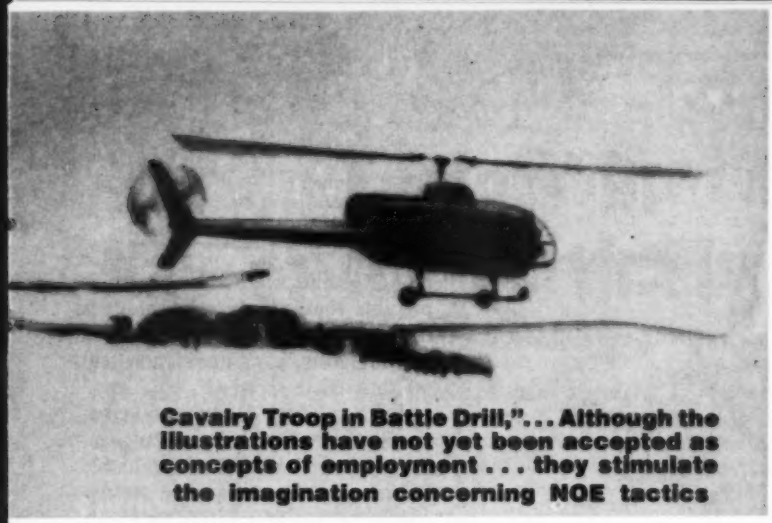
The main task of the attack helicopter is to bring its ordnance to bear against the enemy threat. The primary mission of the air cavalry troop is to extend, by ground and air means, the reconnaissance and security capabilities of the parent or supported organization. But the present and near-future high air defense threat environment will make air-to-air engagement with enemy aircraft highly probable. Thus, the big question is: How does one survive and accomplish assigned missions?

Attack helicopter elements (formations) will be vulnerable to attack by enemy air elements anytime while marshaling; moving to the attack; attacking; and following the attack (subsequent reengagement or retirement).

Continuous defensive tactics are necessary to offset an enemy aircraft attack. While en route personnel of the armed helicopter force should constantly search the skies to detect threatening aircraft at the earliest possible moment. If they are spotted a brief, clear report should be standard operating procedure to spread the alert; e.g., "Dragon 36, eight bandits, 3 o'clock high, 2 miles." If the armed helicopter force is operating independently of elements that could counter the attack, evasive action should be taken immediately.

Nap-of-the-earth (NOE) techniques are highly effective against high performance aircraft which have limited capabilities to maneuver effectively at low altitudes. Rapid changes in direction that capitalize on the greater maneuverability of the helicopter, plus judicious use of cover and concealment, minimizes the high performance aircraft's success in making an attack.

Generally, engaging enemy aircraft is a chancy thing—best avoided if there is not a threat to mission performance. But, even when the threat is present enemy aircraft should be fully engaged



Cavalry Troop in Battle Drill,"... Although the illustrations have not yet been accepted as concepts of employment ... they stimulate the imagination concerning NOE tactics

Figure 1: Attack helicopter engaging an enemy aircraft

only when friendly high performance aircraft are unavailable; when air defense artillery cannot neutralize the threat; when there is numerical parity or superiority over the enemy; or when there is no other choice.

When armed helicopters are engaged by enemy rotary wing or low performance fixed-wing aircraft, the sequence of events is:

- Identify the aircraft as enemy.
- Spread the formation.
- Report the enemy position and request air defense artillery and tactical air support.
- Take advantage of all available cover and concealment.
- Maneuver into an attack position.
- Attack.
- Reassemble.
- Continue the original mission.

If engaged by enemy rotary or low performance fixed wing aircraft, a basic consideration is the opponent's ordnance. When the rotary and low performance fixed wing threat does not have air-to-air armament, the attack helicopter armed with a homing missile has a decided advantage (figure 1).

Ideally, the attack helicopter's best missile and acquisition position is the enemy's rear. Whenever the enemy helicopter shows any view of the tail, it should be engaged with the homing missile. When a tail attack position cannot be acquired the opposing aircraft can be engaged head-on (figure 2) or at an angle using the attack helicopter's turret weapons systems. The obvious disadvantage is that the enemy also will be firing his armament.

When engaging enemy armed helicopters, the armed helicopter force should present the enemy with a solid front and the maximum appropriate firepower available. When functioning as an escort of a large helicopter force, all effort should be made to engage the threat outside of the escorted formation. The escort should not be broken until the enemy has committed his forces for the attack. Then the enemy's armed helicopters should be destroyed or driven from the area.

In attacking an enemy low performance aircraft with two attack helicopters, the best tactic would be to use a split team attack, forcing the enemy to show his tail to at least one.

If both the friendly and enemy aircraft have homing-type missiles, it is best to present forward profiles and utilize concealment; then the most likely development will be a standoff. However, victory will probably be influenced by the best use of concealment, protective cover and especially initial surprise.

Attack by high performance aircraft may come under varying situations and approaches. When this occurs the usual sequence of events is:

- Identify the aircraft as enemy.
- Spread the formation.
- Take advantage of cover and concealment.
- Report the enemy and request air defense artillery and tactical air support.
- If forward of the line of contact, maneuver back to it.
- Reassemble.
- Continue original mission.

Figure 2: Helicopter lifted for firing head-on

Figure 3: Helicopters in defensive circling posture

During the encounter with high performance aircraft, helicopters should fly circling (figure 3); figure eights (figure 4); dives; and sharp turns to rapidly change direction of flight.

The higher speed of the high performance aircraft comes at the cost of decreased maneuverability. The helicopter's best defense is to exploit this by flying nap-of-the-earth mostly in a horizontal plane while employing rapid changes of direction and steep turns using the helicopter's complete speed range. Maneuvering for an attack position should be considered only as the last possible action, but helicopters should still be ready to exploit any opportunity to deliver fire or launch a homing missile toward the tailpipe of the high performance aircraft when a 6 o'clock position is acquired.

Because high performance aircraft operate in a limited turn radius, the helicopter usually can operate inside the circle of the enemy's capability. Thus, the helicopter pilot can keep the attacker in sight. He must strive to always acquire a 6 o'clock position relative to the attacker's flight direction regardless of the range opening to the attacker. This continued forcing of the attacker to break visual contact provides an effective defense. It may furnish time for adequate concealment and, by maneuvering to the opponent's rear, it also maximizes best homing launch situations.

The armed helicopter formation should make every effort to prevent the high performance attacking aircraft from penetrating the formation under escort. The pilot should maintain his established flight path until the enemy begins his attack dive. He then turns immediately toward the enemy aircraft and employs maximum firepower so that the attacker must fly through a cone of fire. After the initial enemy pass, the armed helicopter will take predetermined defensive action.

This article is not intended to disseminate Army doctrine, but hopefully to stimulate thinking that challenges the basic information presented and to seek improvement through practice and modification to fit specific situations. It also is possible that additional techniques may be developed through the use of simulators, computerization and operational tests.

Each military confrontation between nations provides many lessons and vast amounts of invaluable information. It guarantees the dynamic nature of military concepts and materiel. The Arab/Israeli war of 1973 showed conclusively many weaknesses in Soviet materiel and concepts; however, it also reflected that present and projected missilery development indicates the strong possibility that we may not always have tactical air support or cover in forward areas. Additionally, the Israeli forces successfully improvised ground tactics to counter the effectiveness of advance ground-to-air missile systems that temporarily prevented control of the air.

The point is: there is always a counter to every offense, but it is a lot cheaper in materiel and lives to develop these outside of a do-or-die environment and to profit by the mistakes and experiences of others. In other words, *it's getting late; now is the time to develop and test helicopter air-to-air combat tactics, techniques, procedures and appropriate air-to-air weaponry!*

Figure 4: Helicopters in figure eight defensive posture

TACTICS outlook

Human Factors In Nap-of-the-Earth Flying

Aeromedic

Provided by the Society of U. S. Army Flight Surgeons

Part II: Protection Against The External Environment

Lieutenant Colonel Nicholas E. Barreca, M.D.

LAST MONTH the importance of our sensory systems was discussed in the perspective of the nap-of-the-earth (NOE) flying environment. The capabilities and limitations of both unassisted and assisted sensory perception must be at the forefront of consciousness during all conditions of flight over which we have positive control. What about those instances where control is marginal or lost for a variety of reasons? Does the crew have the same or fewer options than it did under flight or mission profiles antecedent to NOE?

Certainly the stresses placed on man and machine are increased. The risk of an accident is then potentially higher, unless one learns to cope with new threats and new limitations. Operating very close to the ground the useful options or alternatives are limited when an emergency situation presents itself.

Frequent power changes; twisting, torquing, straining metal; operating out of ground effect—all these place new additional stresses on the aircraft that must be accounted for and designed around.

Rapid visual and aircraft clearance of suddenly appearing wires, obstacles, trees and foliage place new and frequently challenging stresses on the pilot in the emergency that leads to accident or combat loss. The objective in either case is the minimization of personnel losses, whether the emergency occurs under accidental or combat conditions.

In the past helicopter crews depended primarily upon the autorotative maneuver to salvage men and equipment in the face of an emergency. This maneuver is acceptable when ideal landing sites are recognized and when the aircraft is positively controlled (i.e., necessary altitude, attitude and airspeed). How has the U. S. Army performed in accidents of the autorotative type? Some figures are revealing. For fiscal years 1970 through 1972 there were 790 autorotative accidents, representing 42.3 percent of all accidents. They accounted for over 89 million dollars in aircraft damage, 92 aircrew fatalities and 652 aircrew injuries. Of these 790, personnel error accounted for 32.7 percent of the accidents, while materiel failures alone accounted for 31.9 percent . . . 20.9 percent were attributed to a combination of personnel error and materiel error and the remaining 15 percent were attributed to other causative factors. The majority of these losses occurred under conditions of peacetime or low-intensity combat.

Depending upon this maneuver alone, how would we fair in the mid- to high-intensity NOE environment? Not too well, it is presumed. Obviously other options must be sought and they have and will be.

The purpose of this section is to discuss and emphasize the other options . . . those that are particularly vital or worthy of consideration in the NOE flying environment. Actually, each of us should be encouraged by the prospects of the future. If past accidents and combat losses are analyzed to see if they could have been survivable given the right option, one finds depending upon the study (service and military population), that more than 80 percent of operational emergency events are survivable. In one recent Army study, more than 90 percent of helicopter accidents were found to be potentially survivable. Let's examine the options for *protection against the external environment* under three headings.

- ***Crash Injury Prevention.*** This includes all those procedures, devices and design features that permit protection, potential or actual, against injury during a crash sequence.
- ***Escape Systems.*** This includes all types of inflight and zero altitude ejection and extraction alternatives.
- ***SERE.*** This includes all the options required after an accident to ensure ultimate success . . . survival, evasion, resistance and escape.

Crash Injury Prevention: Crash injury prevention concepts have been applied for many years now. They have been especially worthy of consideration in the face of the demonstrated poor results we have achieved using the autorotative maneuver. Even more important is their application in the NOE environment.

The application of crash injury prevention concepts must be discussed with the realization that they can be applied under two distinct sets of circumstances. First, when an aircraft, at relatively high altitude (above 50 feet) with useable airspeed can adopt various *controllable* maneuvers to recover the aircraft (i.e., autorotation, running landing, etc.) over reasonably ideal terrain (i.e., runway, open and unsloping terrain, etc.). Second, when an aircraft is *uncontrollable* or lands in relatively hostile or unaccommodating terrain. The NOE environment requires that we strongly consider the needs in the second instance—low altitude, out of the height/velocity curve, usually over uninviting terrain. Let's discuss crash injury prevention in this perspective. The acronym CREEP can help us remember the vital elements of crash injury prevention.

- Crashworthiness
- Restraint
- Energy attenuation
- Environmental delethalization
- Postcrash factors

Crashworthiness refers to the flying vehicle. Is it designed to sustain the expected crash forces without magnifying them or permitting open invasion of the occupants? Does the airframe provide a protective container? This can be achieved by a number of engineering

methods which basically add up to devising a personnel or cargo container that retains most of its integrity while crushing and crumbling in a controlled fashion during a crash sequence.

If the autorotative mode will have limited applicability in the NOE environment and inflight escape proves unfeasible, most of our effort will have to be placed here. It is encouraging to note that the aircraft manufacturers of the UTTAS (utility tactical transport aircraft system), AAH (advanced attack helicopter), HLH (heavy lift helicopter) and other vehicles are speaking in crashworthiness terms.

Restraint refers to the tiedown chain . . . the link between the aircraft occupant and the crashworthy aircraft structure. This consists of the basic seat structure, seat belt, shoulder harness and required anchorage points. Restraints retain the occupants in the protective shell of the aircraft and spread the crash forces reaching them over a larger area. This is one element that each aircrewman has some control over.

Due to the efforts of aviation safety engineering and the U. S. Army Aeromedical Research Laboratory (USAARL) at Ft. Rucker, AL, most current and forthcoming aircraft have reasonably secure and properly designed restraint systems. If in the NOE environment, particularly in combat, we shall risk short notice, poorly controlled crashes then restraint must be optimal. This requires efforts by engineering staffs and aeromedical laboratories and, most importantly, individual preparation. For gunship and other high performance vehicles the use of optimal restraint to include such things as side and groin straps and the like should be considered (see diagram).

The individual must wear whatever he has optimally adjusted, snug and fastened at all times. In most NOE emergencies there will not be time to tighten seat belts or adjust and lock shoulder harnesses. A word to the wise then—optimize your restraint systems at all times when flying NOE.

Energy attenuation refers to the application of engineering methods to limit the crash forces that are delivered to the occupant. Under undesirable conditions, crash forces can even be magnified. This is known as dynamic overshoot. The use of pillows or elastic devices that permit independent acceleration between vehicle and victim fall into this category. If one uses devices that deform or stretch in a controlled fashion, they can attenuate or weaken the crash forces before they reach the occupant. Thus, the seats of the UTTAS, both crew and passenger, will limit the crash forces reaching personnel by virtue of special design considerations (see "Crashworthy Troop Seat Designs," April 1972 DIGEST). These methods again must be optimized in the NOE environment.

[NOTE: It should be noted that some crew stations require unique consideration with respect to seat or station design, restraint and energy attenuation. For the NOE environment the day of the unsophisticated monkey strap must be forever avoided. Special stations for gunners and other crewmembers will have to be carefully designed if they will survive crashes, while still performing necessary functions efficiently.]

Environmental delethalization. Even in the face of optimal crashworthiness design, restraint and energy attenuation, there is still a potentially injurious environment to take into account. Components of the aircraft and other devices can tear loose or develop proximity during a crash sequence and become lethal weapons. This means that the tiedown chain of equipment must be optimally designed. It also means that parts of the inside aircraft structure that can potentially make contact with the occupants must be delethalized. Knobs, switches, projections and controls must be malleable, softly covered or breakaway.

To a large extent personal protective equipment reduces the hazards of the injurious environment. Thus, each aircrewman flying NOE must wear his protective equipment at optimal readiness. During an NOE emergency, there is virtually no time for last minute adjustments. Wear the helmet properly adjusted and fastened with both chin and nape straps snugged. Wear the clear or sun visor down and locked (see "Aeromedic," February 1971 and May 1973 DIGESTs). Wear protective gloves, uniform and boots to protect skin and extremities. A second skin reduces the likelihood of serious abrasions, lacerations and contusions. Leather ankles guard against broken ankles. Delethalization of cockpits is partly the responsibility of design engineers, but each of us can see that cargo and other items are well secured to reduce the risk.

It should be realized that the use of helmet-mounted optical sights or night vision goggles does produce some tradeoff of crash injury protection that is inherent in individual protective equipment. These devices increase the weight placed upon the helmet suspension system, displace the helmet's center of gravity forward and potentially compromise its retention characteristics. In addition, the projection of these devices beyond the body's contours enables them to become potential secondary instruments of injury when they transmit forces incident upon them. Thus, these devices must be designed for safety and should be similarly delethalized.

Postcrash factors. This refers primarily to postcrash fire protection and provisions for adequate emergency egress through exits. For the most part, one can be encouraged by the great success realized with the crashworthy fuel system (see "Evolution—Helicopter Crashworthy Fuel Systems," July 1972 DIGEST). In the NOE environment this kind of protection and time purchase is essential. Fires must propagate slowly or not at all (preferably the latter). All aircraft considered for NOE profiles must certainly have this provision, be they personnel carrier, scout or attack. Of course, in addition to aircraft design for fire protection each individual has fire retardant protective equipment. Again, in the NOE environment, Nomex gloves and flying suits must be worn to maximize fire protection (see "Aeromedic," September 1973 DIGEST).

The provision for adequate exits for egress is generally not a problem in helicopter aircraft. However, more consideration must be given to aircraft crashing inverted or in water.

Escape Systems: For time and memorial the helicopter pilot has depended upon autorotation to extricate himself from emergency situations. On occasion he has even resorted to parachute bailout. The thought of bailing out of a many rotor bladed monster has never been appealing to the helicopter pilot. Appealing or not it has been successfully accomplished in the past (see "Emergency Escape Systems For Helicopters," August 1971 DIGEST). Recently a flight surgeon at the USAARL demonstrated that it could be accomplished safely even under autorotative rates of descent in the order of 3,080 feet per minute. Thus, parachutes should not be considered foreign or hazardous in the helicopter environment.

Let's indict the autorotative maneuver then for just a moment. Isn't it really a limited option? It generally requires altitude and airspeed. Future helicopter designs with increased payloads, higher speeds, and advance blade design with higher disc loadings will require even more altitude. In addition, it cannot be used in the following situations with consistent or expected success:

- loss of main rotor
- loss of tail rotor
- desynchronization of tandem rotors
- power loss/engine failure IMC
- midair collision
- combat damage to control systems
- fire/explosion
- icing
- transmission freeze up
- power settling

If one established certain criteria for an inflight escape system and examined prior accident data, in how many accidents involving the above mishaps could survivability have been improved? This analysis has been performed and the results are rather startling. One important criteria was that helicopter terrain clearance altitude must be 100 feet or more at the onset of the emergency. Applying this criteria to combined accident data of the Army, Navy and Marine Corps between 1958 and 1968, it was found that an inflight escape system could have been effective in 43.3 to 47.1 percent of cases. In addition, a separate fatal accident analysis was performed for Army and Marine Corps AH-1G helicopter operations from September 1967 to September 1970. During that time, 157 pilots were lost—95 due to direct enemy action and 62 in accidents. Of these 157 fatalities, 101 cases involved sufficient information to determine whether an inflight escape system could have prevented the fatalities. Of these cases, 61 percent were judged survivable by means of an inflight escape system.

Perhaps then the admonitions of the Government Accounting Office bear consideration. The ability to autorotate is inherent in helicopter aerodynamics. It comes free of charge, but inflight escape systems do not! Inflight escape systems do, however, provide another interesting option.

Technology is being developed that will permit applicability of escape systems to helicopter aircraft. The many alternatives include sideways ejection and extraction systems, sideward-upward (L-shaped) ejection, blowing blades followed by upward extraction or ejection, blowing blades followed by capsule recovery and total aircraft recovery. Downward ejection has even been considered, but only for special applications.

For multipassenger helicopters analyses indicate the most efficient inflight technique is the capsular approach. One has to account for crew, passengers, casualities, etc. The weight penalty for individual escape systems and the complexity of sequencing would be prohibitive. For small gunship-type helicopters, individual escape systems offer the most practical inflight escape system (see "Cobra Escape System," November 1973 DIGEST).

So, it appears that inflight escape is both feasible and desirable. It is certainly an option that one might want to have available. Its applicability to NOE flight, however, may be limited. At NOE altitudes one likely has insufficient time or altitude to effectively eject or be extracted. Often the aircraft will be masked laterally by terrain providing insurmountable obstacles to the ejection or extraction path. In addition, successful activation of the system, when decision times are brief, may not be possible. Still, with the design of vertical seeking escape systems, these disadvantages might be circumvented or minimized.

Thus, the helicopter crew has to think in terms of the several options they have or will have available when an emergency arises. With power failures at higher altitudes over desirable terrain, the autorotative mode might be the option of choice. It will likely save crew and aircraft. Under other conditions, when the autorotative maneuver cannot be successfully applied and altitude is above 100 feet, inflight escape would be the option of choice. Under NOE conditions all options may be considered depending upon limitations at any point in time, but the one alternative that will likely supervene is flatout crashing the machine. In this instance, all crash-injury prevention modes of CREEP had better be operative.

SERE: Renewed emphasis must be placed on survival, evasion, resistance and escape training requirements in the face of potential mid- to high-intensity conflicts. Army experience in Southeast Asia has perhaps spawned complacency about the extent or duration of our crew survival roles. Due to the seeming omnipresence of fellow aircrewmen or adjacent supporting units, it was seldom that Army aircrewmen went down that they weren't promptly rescued. The premium was thus placed on signaling and communication equipment.

In the future the risk associated with launching search aircraft in great numbers may be so high as to make it prohibitive. Once an aircraft goes down in the NOE environment, it will be difficult to locate the aircraft or pilot without significant exposure risk to search and rescue aircraft. Thus, each of us must be prepared to survive, evade, resist and escape. It is imperative that all aviation commanders place renewed emphasis on these aspects of training at the unit level. Consideration should also be given to the many fine courses in survival given by the Air Force. These could serve as refresher and extension of the fine basic survival techniques taught at Ft. Rucker.

Chaplains' Memorial

DURING AN OUTDOOR memorial service on 26 April at the U. S. Army Aviation Center, Ft. Rucker, AL, the Chaplains' Memorial Activities Room was dedicated to the 16 chaplains who died in Southeast Asia 1964-1971.

The dedication was made by Chaplain (BG) Thaddeus F. Malanowski, Deputy Chief of Chaplains, U. S. Army. Three floral tributes to the deceased chaplains were presented on behalf of all American families, all the mothers of chaplains and all the wives of chaplains.

The Chaplains' Memorial Activities Room was built as a self-help project by members of the Office of the Center Chaplain at Ft. Rucker. The memorial room which can accommodate small groups of up to 70 persons is to be used for various chapel activities.

"When we dedicate this memorial, we must remember that the giving of their lives is a legacy upon which we can continue to draw . . ."

MG WILLIAM J. MADDOX, JR.
Commanding General
U. S. Army Aviation Center

ETERNAL REST

GRANT UNTO THEM,

O LORD

IN MEMORIAM

These Chaplains Died in Southeast Asia
1964-1971

Meir Engel, Army
William Joseph Barragy, Army
William Newcomer Feaster, Army
William John Garrity, Navy
Michael Joseph Quealy, Army
James J. L. Johnson, Army
Ambrosio Salazar Grandea, Army
Vincent Robert Capodanno, Navy
Charles Joseph Watters, Army
Aloysius P. McGonigal, Army
Robert R. Brett, Navy
Morton Harold Singer, Army
Don Laverne Bartley, Army
Roger W. Heinz, Army
Phillip A. Nichols, Army
Merle Dewayne Brown, Army

Far left, top, Chaplain (COL) Walter Wichmanowski, U. S. Army Aviation Center Chaplain, initiates the dedication ceremony. The entry to the memorial room is visible at the right. Bottom photo, Chaplain (BG) Malanowski, Deputy Chief of Chaplains, pays his respects during the dedication address. Left, Chaplain Malanowski cuts the ribbon formally opening the Chaplains' Memorial Activities Room

COUNTERFLAK

Continued from page 7

enemies postulates that airspace violators will be engaged at maximum range by continuous fire from all available means, including small arms.

The use of manned aerial vehicles to provide the required mobility, reconnaissance, security, target acquisition and fire support on the battlefield of the future will depend on our ability to circumvent, actively engage or otherwise nullify the antiaircraft capabilities of the enemy. The means of achieving this may be categorized broadly as follows:

- Hide from visual and electronic acquisition as exemplified in nap-of-the-earth (NOE) flying tactics.
- Use onboard aircraft or ground based electronic devices to obscure or disrupt electronic or infrared (IR) acquisition.
- Use smoke or other man-made obscuration media to reduce visual acuity.
- Destroy or neutralize the hostile antiaircraft means so that the foregoing become academic.

Limiting acquisition will provide some protection for aircraft from the enemy, but if carried to extremes it can have the unacceptable side effect of precluding mission accomplishment in the interest of aircraft survivability. The best deterrent is physical destruction or neutralization. The present capability of the Field Artillery in providing that deterrent is limited to conventional munitions delivered by currently available cannon, attack helicopters in specialized units and, to some extent, missiles. For the future the Field Artillery is in the process of determining and challenging the current capabilities in terminal homing technology, as it applies to air defense suppression, for development of a multimeans capability utilizing cannon, ground delivered missiles/rockets and aerial delivered rockets or missiles.

With respect to cannon, continuous effort is in progress to increase range, mobility, accuracy and lethality. Extended range munitions coupled with terminal homing appears to be entirely feasible and especially effective for flak suppression. A multiple launcher general support rocket system (GSRS) with a range in excess of current cannon capabilities appears to be a reasonable goal. The high rates of fire inherent in such a weapons system seem to invite its use as a counterflak weapon even without terminal homing. A relatively accurate rocket with various warhead concepts should adequately achieve the desired result. Terminal homing, if perfected for GSRS, would yield a geometric increase in effectiveness.

Flak suppression will be the business of everyone with a capability; however, it will be the special province of division artillery and those units not in direct support of a maneuver force. Corps battalions will participate in flak suppression normally as a function of reinforcing the fires of a particular division artillery although corps artillery might, in some instances, direct its own battalions in a counterflak program. Nothing militates against direct support battalions making some contribution; indeed, they could well be the chief flak suppression agencies in the zone of interest of their respective supported brigades with the divisional and corps battalions assuming primacy throughout the corps zone of interest.

The attack helicopter, noted for its mobility and firepower, is equally well endowed with versatility. The potential capability it possesses as a tank killer and deliverer of area fires against a variety of targets also qualifies it as a suppressor of enemy air defense, especially in the zone near the forward edge of the battle area (FEBA). Unfortunately, attack helicop-

ters suffer from vulnerability to the fires of their targets if used with indiscretion. It would seem logical that cannon artillery firing antipersonnel munitions, when in range, is very appropriate for use to subdue the enthusiasm of the exposed crew of a 23 mm antiaircraft gun while an attack helicopter guides a TOW (Tube launched, Optically tracked, Wire guided) missile on target for destruction of the weapon itself.

A combination of rocket firing and TOW equipped attack helicopters in addition to tactical air support could extend the reach of a counterflak program of fires for special operations beyond the range of cannon artillery. In the future this helicopter capability could be greatly enhanced against targets with a radio frequency (RF) signature. Conceptually, an RF seeking missile would be fired in the general direction of a signature box-in-the-sky; from there it would home true on the missile tracking radar or other RF emitters. Admittedly an ambitious development, it is, nevertheless, within the foreseeable development stage.

Artist's concept for employment of the AN/TPQ-36 Counterfire Radar

The role of the Field Artillery in suppressing enemy air defense need not be limited to destruction of hostile weapons with munitions of various types. Radar reflective chaff might be dispensed from Field Artillery projectiles, thus obviating the need to expose manned aircraft with their high intrinsic value and their relatively great vulnerability. Unmanned aircraft could be used to dispense chaff or to cause the enemy to present his electronic signature prematurely for analysis or to conduct short-range, broad-band jamming. Manned Army aircraft may carry a variety of electronic devices for antiaircraft suppression; these would be in convenient packages for hasty addition or removal, as required. The application of these measures would be selective to preclude burdening all aircraft with a blanket issue of exotic electronic devices. A bewildering variety of devices and concepts enjoins detailed coordination between the Field Artillery and other Army agencies with an interest in and a capability for electronic flak suppression. Coordination with the Air Force will be equally as close in this regard. The division tactical operations center (TOC) recommends itself strongly for the purpose, having representatives from all the agencies with an interest in flak suppression.

To neutralize or destroy the hostile air defender, as distinguished from merely confounding him through masking or jamming, requires that he be located with considerable accuracy. Location of hostile air defense weapons and associated supporting elements is a difficult but by no means impossible task. The Field Artillery, whose stock-in-trade is target acquisition, now has a fair capability to locate active hostile air defense sites; it promises to improve vastly with the introduction of new systems in the next 3 to 5 years. With a requirement to be positioned in relatively open areas, enemy weapons (both gun and missile) offer a pronounced visual signature in most cases. Unmanned aircraft using photographic or IR imagery can provide locations accurate enough for counterfire within 30 to 40 minutes if current plans are implemented to introduce a drone into the inventory. Moreover, active air defense weapons positioned relatively near the FEBA are subject to location with varying degrees of precision by even unaided ground or aerial observers and scouts.

Enhanced by range finders, now well advanced in research and development, both maneuver unit and Field Artillery observers can make locations within a few meters if they are sited on terrain sufficiently commanding to permit direct line of sight.

An active gun-type air defense weapon offers another excellent signature in the projectiles themselves. The current Field Artillery countermortar radar is capable of determining locations within 50 meters from an extrapolation of the trajectory of projectiles observed in flight. New countermortar and counterbattery radars are progressing rapidly in research and development and will do this job even better. An effort is underway to exploit this potential with respect to the location of antiaircraft weapons; it appears location of the larger antiaircraft cannon by the countermortar radar may be feasible. Target acquisition techniques of the more distant future may take advantage of IR, gravimetric, seismic or other signatures permitting location of hostile air defense under a variety of conditions. It is significant that target acquisition means function within a highly developed and well tested system dedicated to accuracy and rapid response.

The integration of the counterflak program into the overall maneuver scheme will be a task of the first magnitude, demanding of the fire support coordinator his most inspired work. Although this coordination can and will be done at all levels, the division seems a likely place for the execution of the more complex schemes. Picture a mid-intensity battlefield with United States forces on the offensive after an initial delay to deploy sufficient forces to stop the enemy and then to reverse the tide of battle. The enemy is withdrawing in an orderly manner but is faced with traversing a mountain defile with one of his motorized divisions. If elements of a U. S. armored corps could block the pass for 12 to 18 hours, the possibility is considerable that the superior U. S. force could close with and destroy most or all of the aggressor force with its sole escape route blocked.

The U. S. corps commander directs that an airmobile brigade-sized task force secure the defile and block the aggressor escape for 12 to 18 hours. The defile is 34 kilometers from the current line of contact and the enemy in between retains unit integrity, has good morale, and is equipped with SAMs (surface-to-air missiles), 57 mm and 23 mm antiaircraft weapons. The mission and the airmobile task force assets are given to a U. S. armored division in line with the objective. The stage is now set for the execution of a flak suppression mission of Herculean proportions if the task force is to be deposited safely on the objective. Enter the fire support coordinator and his assistant fire support coordinator who habitually works at the division fire support element (FSE). His task is to orchestrate the target acquisition means, the indirect fires and the aerially delivered fires to clear a corridor from the line of contact to the landing zones (LZs) in the vicinity of the objective.

Consider first the determination of the location of the hostile antiaircraft weapons. The fire support coordinator (FSCOORD), who is also the division artillery commander, has available information from all the target acquisition devices operating in the Field Artillery system from those corps assets in his sector down to those of the direct support (DS) battalions of his division artillery. He also has access to the more limited means available to the maneuver units and intelligence data collected by corps from its assets and those of Air Force sources. Of particular interest for this airmobile operation are drone aircraft with cameras and IR, unattended ground sensors and countermortar radars.

At H-6 hours the FSCOORD directs the launch of drones to fly down the long axis of the several potential flight routes provided by the airmobile task force commander. Three countermortar radars are "looking" down the proposed corridors continuously during the drone flights and locate three fire units of undetermined type. The locations are transmitted to the division artillery tactical fire direction system (TACFIRE) where they are processed and held pending evaluation. The FSCOORD has directed that the counterfire status be semiactive in the area of the recommended corridor. It is felt that antiaircraft weapons located in that zone during that period will not reposition themselves and to fire on them prematurely could compromise the mission or give them time to move or recover. The semiactive counterfire status recognized this and fire is held at that time.

The drones complete the mission and the imagery, rapidly developed, is used to recommend the least hazardous route to the airmobile task force commander. A route with eight suspect antiaircraft locations is selected. Three locations correlate closely with radar determined locations. The locations already in TACFIRE are corrected to read the same as those determined with greater accuracy from the photographic imagery using photogrammetric equipment. With the aid of TACFIRE working at electronic speed in its target intelligence mode, it is determined that previously recorded sensor reports and three of the other suspect locations correlate. A fourth location

falls within 100 meters of a location determined by a radio frequency emitter locator; its analyzed frequency indicates a radar of the type used on the 23 mm antiaircraft weapons. The eighth location does not correlate with any other information, but is a logical antiaircraft site and is included in the target list. These are priority targets in the schedule to be fired in support of the airmobile operation. Also included are suspect locations determined by a variety of means to include reasonable inference.

A particularly lengthy list of targets near the line of contact is entered in TACFIRE for small arms, machineguns and other crew-served weapons must also be suppressed. TACFIRE accepts these and, again with electronic speed, develops an artillery schedule of fires that includes the fires of artillery attack helicopters that come with the airmobile force. It is determined that some of the targets should not be fired; however, they are placed on-call for possible use. Several thousand meters of the sector fall beyond cannon range and those targets are assigned to the general support rocket system. Aerial escort and fire support attack helicopter fires are minimally scheduled and are thus held as an ace-in-the-hole asset by the task force commander to be used against late developing and deep targets. Most of the near targets are assigned to the division artillery general support battalion and a heavy reinforcing battalion from corps artillery. Some of the closer targets are assigned to DS battalions that can range the corridor.

Now the FSCOORD integrates the allocated tactical air sorties available for the operation. Generally their use is planned in the area beyond cannon range always keeping in mind their vulnerability to antiaircraft. The schedule is now complete; it is not associated with the clock time but with H-hour, the time the lead assault helicopter passes a well defined checkpoint 6 kilometers to the rear of the FEBA. The corridor is divided into 12 increments of roughly equal size and these are given alphanumeric identifiers for future references by forward observers (FOs), fire support officers and FACs.

When the lead aircraft crosses the checkpoint, the preparation begins in the sector nearest the line of contact lifting or shifting only seconds before the arrival of the lead aircraft and continues in the next sector always about 30 seconds ahead of the aircraft. Rifle and machinegun fire is desultory; three aircraft sustain light damage but continue.

The airmobile brigade's fire support officer reports two neutralized 23 mm positions and one 57 mm position destroyed in the first 8 kilometers. The artillery FO of the lead company detects a SAM site and three escorting attack helicopters engage and neutralize it but only after losing one of their number. An unexpected heavy concentration of 57 mm weapons is located near the objective. All are engaged by all available attack helicopters while the task force begins landing in a rapidly chosen location offset from the original LZ by 1.5 kilometers. The attack helicopters successfully neutralize the 57 s, losing two aircraft in the process. Support tactical air is called for destruction of the target. The force lands without further damage and the objective is secured.

During return of the assault helicopters, airborne FOs and an FAC overwatch the entire operation and generate missions as targets of opportunity develop. A 57 mm site detected by an FO is neutralized by an on-call airstrike before any damage can be done to the friendly force. Two 23 mm antiaircraft self-propelled weapons are destroyed by attack helicopters firing TOW missiles as the enemy weapons pull to a halt after a hasty entry into the corridor.

The operation succeeded because it was bold but not foolhardy; the hostile force was destroyed or captured at minimal cost to the U. S. corps. The difference between bold and foolhardy is to be found in the judicious use of the means available to suppress the hostile air defense weapons. Detailed preparation and the use of all available assets to locate the enemy air defense weapons coupled with the ability to adjust and react to the air defense threat were the determinants. The ability to perform in this fashion as a matter of routine will be the *sine qua non* of victory on the battlefield of the near—not distant —future, as demonstrated in the recent Middle East conflict. The Field Artillery is by virtue of organization, equipment and training the arm best disposed to execute the air defense suppression function.

General Ott is Commandant of the U. S. Army Field Artillery School. During World War II he entered the Army and served as a forward observer in the 868th Field Artillery Battalion

THIS ARTICLE affords a look at the latest aviation forward area refueling equipment (FARE) which is a significant improvement over more limited systems available during the early hostilities in the Republic of Vietnam. At that time it took at least 30 minutes to refuel a flight of 10 UH-1s from 2,000 gallon tankers. And, we had to shut down! The capability of placing together up to five FARE systems enables us to refuel 10 Hueys in about 7 minutes without shutting down.

But, equipment is only half of the game. Refueling demands safe precision teamwork. This in turn calls for the elimination of artificial restrictions that hamper training operations. While aircraft have burned from mistakes made during hot refueling, we can impose safe procedures on our people and insist that they be followed. The tactical gain in short turnaround time demands that we make the effort to train properly. The environment around aircraft refueling training areas should reflect the same dedicated professionalism and efficiency common to Army rifle ranges. Accidents on Army rifle ranges are rare; the same must hold true in flight refueling areas. Next month the DIGEST will feature an article on aircraft refueling, covering the safety aspects of hot refueling. In a future issue an article will feature unit training for hot refueling operations.

MG WILLIAM J. MADDOX, JR.
Commanding General
U. S. Army Aviation Center

A Fresh Look At FARE

Major J. J. Cecelic and Major L. E. Warner

U. S. Army Quartermaster School

FARE—a simple and efficient fuel dispensing system—was type classified as "standard" by the Army in September 1972. FARE is the acronym for forward area refueling equipment and is a set of components selected to function as an easy-to-operate, lightweight, air transportable refueling system for use in extreme forward areas. FARE will provide the desired mobility, tactical dispersion and flexibility to meet the Army's refueling needs in aviation and nonaviation units. Contracts have been signed and production is now scheduled to begin in September 1974. Production tests will take place probably sometime this summer and high priority units will begin to get the equipment early in 1975 as systems become available.

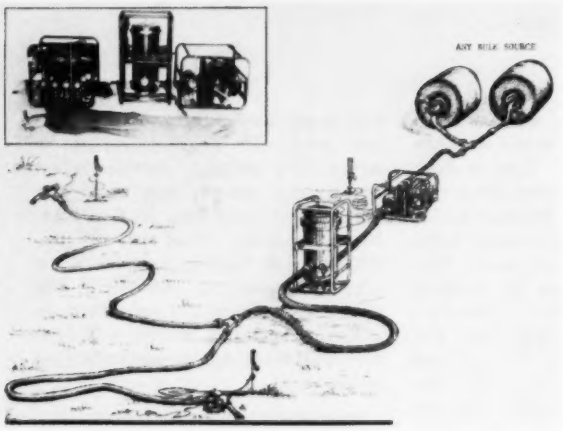
FARE and its forerunners under other project names has been under development since 1962. Since its inception it has undergone many design changes to improve its performance. It was also field tested extensively in the Republic of Vietnam and the experience gained there resulted in many changes in component design. As it now stands FARE is an extremely flexible system.

Flexibility and Dispersion: The system consists of a gasoline engine-driven centrifugal pump, a lightweight filter-separator, two closed-circuit refueling nozzles, 300 feet of discharge hose, 60 feet of suction hose and miscellaneous fittings, valves and accessories. It is capable of dispensing fuel through two nozzles simultaneously, with flow rates up to 50 gallons per minute through each nozzle. The maximum flow rate possible when fuel is being dispensed through a single nozzle is about 80 gpm. Actual delivery rates will depend upon the bulk fuel supply sources and the maximum safe fuel acceptance rate for the vehicle being fueled. If more than two nozzles are required for a refueling operation, multiples of the FARE can be used.

Any available bulk fuel storage may be used to supply fuel to the FARE. The 500-gallon collapsible drum is expected to be the primary source of supply since the FARE will be used in extreme forward areas where other types of fuel storage or pipelines are not usually found.

Because of the high pressure flow in the dry-break fitting through which the drum is filled and emptied, the maximum possible flow rate is limited to less than 100 gpm when fuel is being dispensed from one 500-gallon drum. This is currently being rectified by the Mobility Equipment Research and Development Center, Army Materiel Command.

Transportability: When packaged for movement the entire FARE is contained in six packages, each of which can be loaded, unloaded and emplaced by two men—well, two strong men. The pump and filter-separator are transported as individual items. The suction hoses and ground rods are packed in two canvas bags, each package weighing about 100



pounds. The discharge hoses, fittings and accessories are packed in two tubular frames, each weighing about 140 pounds. Packed for transport, the FARE weighs 675 pounds and occupies 39 cubic feet. No special towing or lifting equipment is required at any stage in packing, transporting or setting up for operation. It can be transported between locations by UH-1 series aircraft or by a ¼-ton vehicle. The weight and cubage allow the FARE to be transported either internally or externally by Army cargo and utility aircraft.

Safety: No need to shut off aircraft engines when refueling with FARE. This timesaver, of course, sometimes becomes an important safety factor in itself during emergency combat missions. The FARE has a number of built-in safety features. First, fuel is dispensed through closed-circuit refueling nozzles which eliminate the possibility of fuel spillage or entry of airborne contaminants into the fuel stream.

Closed-circuit refueling is a system for direct connection of the fuel supply line to the fuel tank of the vehicle to be fueled. In addition to its safety features, it is important for quality control. The system incorporates three components: a vehicle receiver, a closed-circuit refueling nozzle and a gravity fill adapter. The vehicle receiver is permanently mounted in the vehicle to be refueled. The closed-circuit refueling nozzle and the gravity fill adapter are parts of the refueling system.

FARE is a flexible system; when more than two nozzles are needed multiples of the FARE can be used

In the UH-1 aircraft, for example, the aircraft receiver is mounted in the fill port of the fuel tank to provide direct connection of the closed-circuit refueling nozzle to the aircraft. The receiver contains a float-actuated flow control valve which shuts off fuel flow into the aircraft when the fuel reaches a predetermined level. The same valve closes if the refueling rate exceeds the maximum flow rate for the particular aircraft being refueled. Some aircraft have already been fitted with the closed-circuit refueling receiver. The modification will be completed on other aircraft as the FARE becomes available in the supply system.

Another safety feature is that fueling points can be located as much as 300 feet apart and at least 150 feet from the fuel source, using just one FARE system. Second and third FARE systems can be as far apart as the tactical situation demands.

To combat static electricity the FARE is equipped with three ground rods. When properly driven into the ground, these rods dissipate the static electricity from the system. One ground rod serves as a common ground for the pump and the filter-separator which are bonded with ground cables. A ground rod is furnished for each refueling point for grounding the nozzles. Each nozzle is equipped with a ground cable assembly for bonding the nozzle to the ground rod and to the vehicle to be refueled.

Description of Components: The FARE pump is a self-priming centrifugal pump driven by a 3 horsepower military model standard engine. The pump is mounted in a tubular protective frame. The engine is equipped with a spark-arresting muffler. A fire extinguisher is mounted on the protective frame. Incidentally, the protective frame is one of the items that has been improved since the early models. The new frame can withstand the stresses and rough handling of transport without damage.

The filter-separator included in the FARE is a 100 gpm unit equipped with a water level sight gauge, a manually operated water drain valve and a differential pressure indicator. It is a two-stage, vertical type unit designed to remove water and solid contaminants from fuels at rates up to 125 gpm. This unit is also mounted in a high-strength tubular frame.

A variety of units are scheduled to receive the FARE—including aviation, field artillery, supply, petroleum, armor and infantry units.

FARE is used with the closed circuit refueling system, however, it can be used with the gravity fill adapter as shown

VIEWS FROM READERS

Continued from page 1

branch experience prior to attending flight school, your appreciation and understanding of the ground commander's problem-solving process should be quite broad. In this light, the commissioned aviator today with branch qualification, like yourself, has many avenues available to advance to the highest positions of responsibility within the Army.

After many years of struggling to prove ourselves as sincere, dedicated professional officers, as well as a group possessing an additional skill in aviation, Army aviators formally established themselves as members of the Combined Arms Team during the Vietnam era. The struggle has been long and hard; however, today the attitudes toward the commissioned aviator within the Army have progressed to the point where a nonrated officer could care less whether his subordinates are aviators or not. Many times commanders have requested commissioned aviators be assigned to their commands in order to gain the expertise from their third-dimensional qualifications.

We have arrived at our firmly established position today for several reasons; first, because of an overwhelming display of professionalism and ability to foster innovative ideas; second, because airmobility can provide breakthroughs in tactics and firepower with its only limiting factor, the imagination of the user; third, due to the demonstrated responsiveness to the ground commander through integration of Army aviation throughout the Army.

Obviously, the words "just an additional skill" were not meant to degrade the importance the Army places on its aviators or the aviation mission. Further, these words are not meant to imply that being a professional commissioned aviator is a part-time business. As we all recognize, an aviation career is a demanding one and requires an officer with more than a normal amount of dedication. The term "additional skill" refers to how the Army views the aviation skill from a personal management viewpoint.

There are some, as you point out, who feel that aviation should be a separate branch; however, a separate branch would not produce commissioned officers with the broad qualifications the Army needs to accomplish its mission-sustained ground combat. The mission of Army aviation is to contribute to the combat capability of the Army and requires that commissioned officer aviators be well grounded in the tactics of the Combined Arms Team. Aviators participate directly in the planning and execution of ground combat operations. The infusion and cross-fertilization of branch qualification and aviation expertise throughout the commissioned officer ranks, both rated and nonrated, results in more effective employment of all the resources on the battlefield. With this infusion and cross-fertilization, the commander fighting the battle not only can be more successful but also, and most importantly, can save lives.

Why is aviation not an OPMS specialty (what you refer to as a secondary career field)? Again, there are pros and cons, but the basic reason is that requirements for aviators are found in many OPMS specialties, as described in the recently released DA Pamphlet 600-3. Thus, by treating aviation as an additional skill rather than a separate specialty, aviators' careers can be developed in the specialties in which this skill is required concurrently with the development of their aviation expertise. The aviator's opportunities for service are thus enhanced to a far greater degree than those of his nonrated contemporaries.

You have my best wishes for your success.

James H. Merryman
Brigadier General, GS
Director of Army Aviation

Sir:

Two articles in the September DIGEST, "Just Pure Hell" and the "Aeromedic" feature, were especially thought-provoking and have inspired me to seek some information.

I have heard it said by persons not necessarily knowledgeable that the fire retardant qualities of Nomex can prevent scorched lungs which are a frequent by-product of fires. In previous discussions, professional race car drivers have been cited as examples; they frequently wear surgical type masks made of Nomex material. Another theory I've heard about race drivers' masks is that they are worn solely for protection from rocks, bugs, etc.

Will you please set the record straight, and tell me if any study has been made of the possibility of minimizing scorched lung injuries by breathing through Nomex?

CPT James H. Kurtz
3d Armored Division
APO 09074

• The DIGEST received the following reply from U.S. Army Aeromedical Research Laboratory:

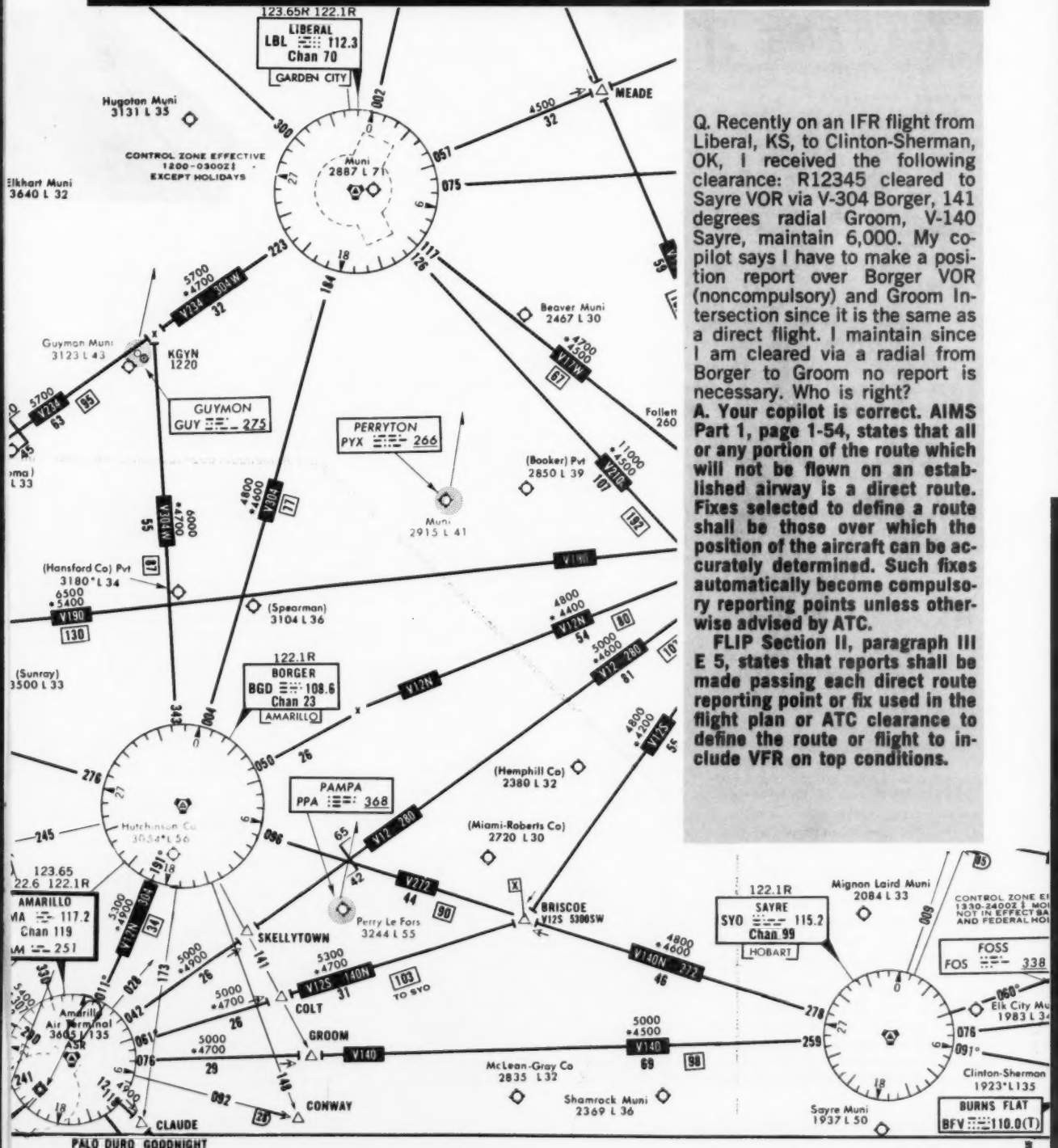
In answer to Captain Kurtz' inquiry of 16 October 1973, Nomex does decrease thermal injury to the exposed wearer, i.e., protects against contact burns. There have been no formal research efforts to explore the reduction of inhaled gas temperature by this technique, however. There has been some very limited work at Natick (Mr. McQuade, U.S. Army Natick Labs, AUTOVON 955-2370) which suggests that the air trapped between the helmet visor (in the down position) and the head did afford a very short protective effect to the respiratory system. The volume of trapped air between the mask and the head would be much smaller than for a helmet and, it would seem, offer less protection from either an insulation or dilution effect. Nomex does not claim to filter out toxic fumes or heat.

As well as providing increased protection against facial burns, a mask would to some extent ward off bugs and other flying debris. On the positive side, it might also afford comfort in colder climates. Possible or probable disadvantages might include interference with communications for military operators, difficult or unsatisfactory adjustment of helmet retention system, and questionable acceptance by aviators and combat vehicle operators, especially in warm climates.

Sir:

Effective 1 July 1974 waivers of the 48 month active commissioned service limitation contained in paragraph 2-1e, AR 611-110 (Selection and Training of Army Aviation Officers) will no longer be granted. Until then, waivers up to a maximum of 60 months may be approved on a case by case basis with appropriate justification. Subsequent to 1 July 1974 waivers of both CONUS and oversea stabilization policy to attend U. S. Army flight training will be considered on an individual case basis. U. S. ARMY MILITARY PERSONNEL CENTER

INSTRUMENT CORNER



Q. Recently on an IFR flight from Liberal, KS, to Clinton-Sherman, OK, I received the following clearance: R12345 cleared to Sayre VOR via V-304 Borger, 141 degrees radial Groom, V-140 Sayre, maintain 6,000. My copilot says I have to make a position report over Borger VOR (noncompulsory) and Groom Intersection since it is the same as a direct flight. I maintain since I am cleared via a radial from Borger to Groom no report is necessary. Who is right?

A. Your copilot is correct. AIMS Part 1, page 1-54, states that all or any portion of the route which will not be flown on an established airway is a direct route. Fixes selected to define a route shall be those over which the position of the aircraft can be accurately determined. Such fixes automatically become compulsory reporting points unless otherwise advised by ATC.

FLIP Section II, paragraph III E 5, states that reports shall be made passing each direct route reporting point or fix used in the flight plan or ATC clearance to define the route or flight to include VFR on top conditions.

Continued from page 3

crease the number of courses of action available for counterattacks. Probably the most significant aspect of employing airmobile assets in the defense is the great advantage to be gained when arming helicopters with our new antiarmor weapons—specifically the TOW (Tube launched, Optically tracked, Wire guided) missile.

During the fall of 1971 the 82d Airborne Division, assisted by the Combat Developments Command Infantry Agency, conducted a field exercise to determine the practicability and advantages of deploying small antitank hunter-killer teams by helicopter. These teams, armed with TOW and Dragon, were deployed by OH-58s to selected points to destroy advancing tanks and force the aggressor to deploy his unit. Then the teams were extracted and redeployed to new positions before the aggressor could close in. Results indicated a kill ratio in favor of the hunter-killer teams. Success in the operation requires expert teamwork between the aviators and ground elements. The aviator must have an appreciation for the tactics employed by the antitank teams and use NOE flight techniques to insert the teams in or near ambush sites and for extraction from prearranged pickup points after disclosure of the firing position. Timeliness of the helicopter is critical to the survival of the antitank team and extensive training is essential.

Today, to provide airmobility for the Infantry, we rely on the UH-1.

This role will be filled by the utility tactical transport aircraft system (UTTAS) (figure 3). The UTTAS will provide a substantial increase in capabilities over the UH-1. The improved combat effectiveness features of the UTTAS are critical to future Infantry operations. For the first time we will

Figure 2: Above, in hasty river crossings ... airmobile units can seize crossing sites before the enemy could defend them effectively

Figure 3: Right, the UTTAS combines features of tactical and strategic mobility. Sikorsky and Boeing are preparing prototypes of the UTTAS

have a true squad carrier. With UTTAS, rifle squad integrity can be maintained during aerial movement and crew-served weapons (TOW and mortar) can be moved about the battlefield more efficiently.

Survivability of the UTTAS against small arms fire is being designed into the critical components of the system; and substantial improvements in vertical lift performance will permit operations at temperatures and altitudes virtually prohibited with today's UH-1H Huey. The UTTAS combines features of both tactical mobility and strategic mobility. Two UTTAS will be transported by the C-141 to any conflict area and can be prepared for combat operations in about 2 hours upon arrival in theater.

Infantry visualizes a continuing requirement for attack helicopter units on the mid-intensity battlefield. It is our view that the attack helicopter will perform those missions shown in figure 4.

Our concept for attack helicopter employment is threefold (figure 5).

During LAMSON 719 there were never enough gunships to meet all requirements. When the action was hot, everyone needed gunships—units making combat assaults, medevac flights and ground units requiring aerial fire support and resupply flights. We are convinced that lift units must have organic escort gunships. To wait for gunships being employed in a different support mission before starting an airlift would sacrifice much of the mobility advantage that helicopters can give us. Attack helicopters, organic to aviation battalions of Infantry and Airborne divisions, will provide escort and close air support for airmobile operations. In the airmobile division the attack helicopter company of the assault helicopter battalion should continue to provide armed aerial escort for assault helicopter companies and provide close air support when not engaged in airlift operations.

Figure 4

- **Aerial attack force**
- **Aerial reconnaissance and security**
- **Aerial fire support**
- **Aerial escort**

In order to keep our attention focused on the hypothetical battlefield of the future and to constantly seek improvements in our airmobility doctrine, organizations and equipment, we participate in the development of standard scenarios. These scenarios provide a background for continuous introspective evaluation of all our forces. As shortcomings are identified, corrective actions are taken to provide our forces the best possible organization, training, doctrine, tactics and techniques for employment against the postulated threat.

We recognize that the mid-intensity battlefield will place increased demands on an Infantry commander's ability to control his force. Not only does the Infantry commander and his staff have more complex tools to manage but they also will have less time than anyone before them. In a given battle all forces (e.g., maneuver, fire support, logistical) must be orchestrated precisely in order to achieve success. To increase our officers' skills, the Infantry School has developed a unique training device—the Combined Arms Tactical Training Simulator (CATTS). This simulator consists of a utility helicopter-communications mockup, and a detailed terrain model of the battlefield (figure 6). Although a helicopter mockup is used to provide the command and control facilities for this simulation, the emphasis is placed on techniques of command/control of tactical resources and coordination within the command party.

In this command and control mockup, each year approximately 1,500 advance course students, reserve officer refresher students and active battalion commanders play the role of battalion commanders and staff officers planning and conducting airmobile operations. Realism is enhanced by using terrain boards to portray the tactical situation and by using realistic sound effects and radio transmissions. This simulator is designed to bridge the gap between doctrinal theory and actual combat, and to increase the effectiveness and realism associated with problems of command and control. Although the present CATTS is a locally fabricated innovation, we have plans for a more sophisticated trainer. The Stage III CATTS will provide

Figure 5

1. **Division and above in aerial attack force units and aerial reconnaissance and security units for offensive and defensive operations as part of the maneuver force in the Combined Arms Team.**
2. **Division artillery and above in aerial fire support units for aerial combat support as an extension of tube artillery fires.**
3. **Infantry-type divisions and below in aerial escort units to escort assault helicopters.**

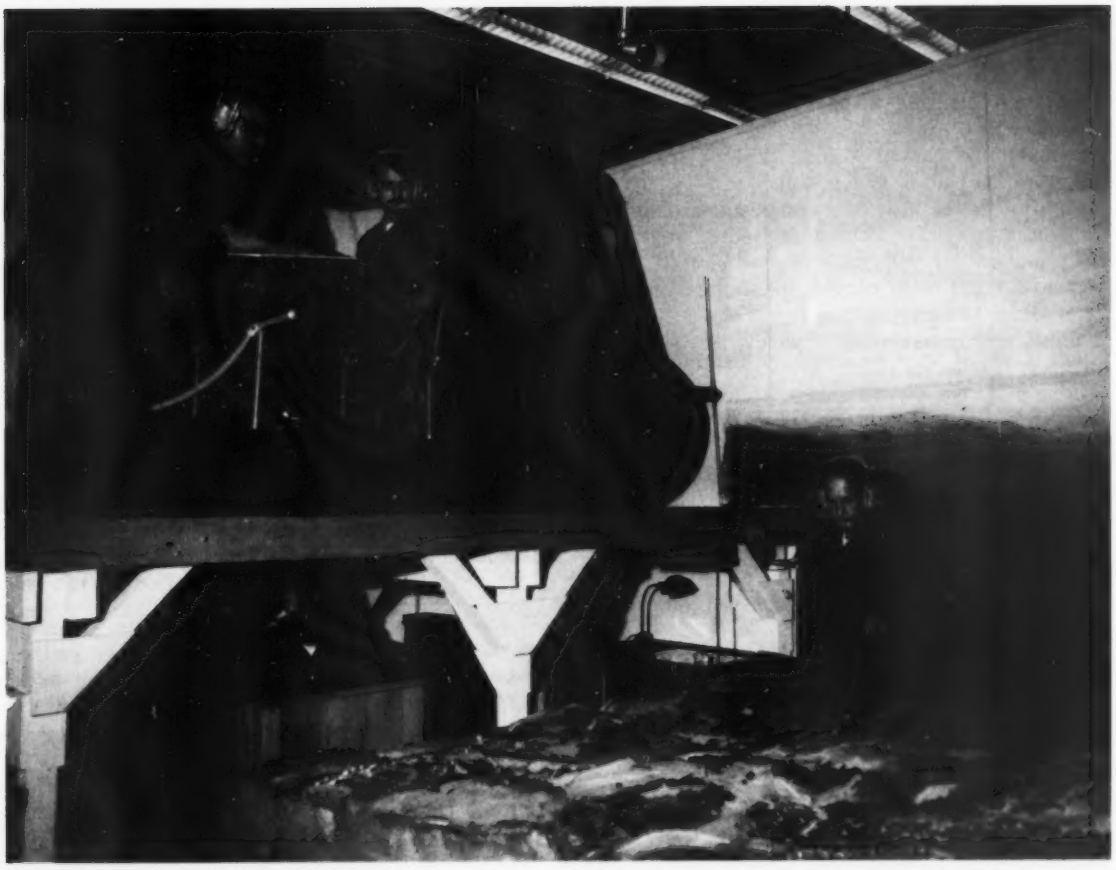


Figure 6: Above, in the Combined Arms Tactical Training Simulator students serve as the battalion commander and his staff in planning and conducting air-mobile operations. Below, a detailed terrain model of the battlefield enhances the training with a realistic portrayal of the tactical situation

advances in technology, to include computer support and audio/visual display systems. It initially will be developed in a ground simulation employing mechanized vehicle mockups. An airmobile simulation will be developed as the final stage of the project.

In summary, we believe that aerial systems will make a significant contribution to our success on the mid-intensity battlefield. While recent years have demonstrated the capabilities of Army aviation to assist the combat Infantry, continuing effort must be devoted to fully exploit the development and potential of aerial systems.

FIRST, CATCH THE RABBIT

continued from page 5

the thing that caused a great deal of attention in NASA to be paid to system safety.

Ball: Just as the visit of a congressional committee to Korea in 1951 focused high-level government attention on the reliability of our aircraft, so the Apollo fire did bring congressional attention to system safety. The investigation report was 3,200 pages, I think, and it was done in an extremely objective manner. It reflected tremendous credit on the people who did it. No punches were pulled. The Apollo fire pointed up flaws in the design of Apollo equipment. Since then, fire-resistant materials in the cabin and in astronaut space suits have replaced those that were more flammable. Metal enclosures now encase loose wiring, and a new escape hatch was designed to open in a few seconds. The hatch in Apollo 204 required about 90 seconds to open. The followup did involve congressional-level action. It led to the setting up by executive order of what we call the Aerospace Safety Advisory Panel (ASAP). Aerospace management recognized that a reliability program is not enough—that we must have a system safety program which looks at the overall management structure.

It is true that this was a major intensification of top management involvement. There had always been a tendency to believe that the designer carried the whole responsibility, but the Apollo fire forced the recognition that line management—program management—really cannot delegate the responsibility for safety. Now my own director, Dr. Petrone, is absolutely adamant that he is personally and completely responsible for safety. I have the title safety director, but there's no misunderstanding that the center director is The Man. I am staff. It's my job to put the data before him but he has not delegated his personal responsibility for the safety of any program. He has delegated the gathering of data, but he has not delegated his managerial responsibility. He will make

This view of the Skylab cluster was taken from the command module during Skylab 4 mission. The orbital workshop solar panel on the right side was lost during the launch phase

the decisions, not myself.

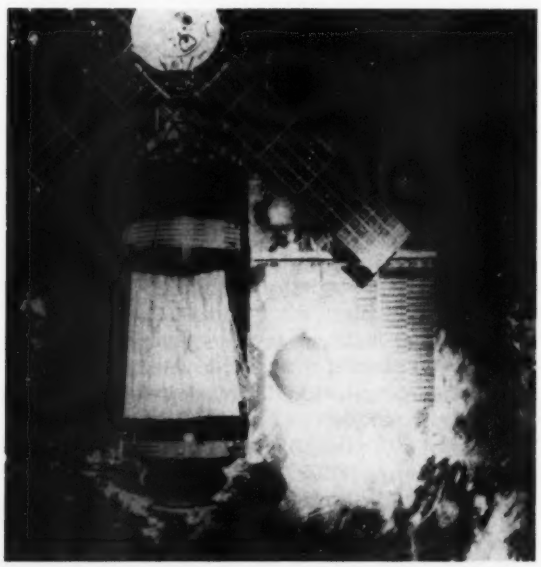
McCullar: We often see a commander placing the full responsibility on his safety officer.

Ball: Whether it's the NASA Center, an industrial company or a military command, the safety officer's job is to assure that there is systematic hazard identification, hazard control action and evaluation of hazard controls leading to the point where the data needed by the commander is available to him so that he can fulfill his undelegatable responsibility for the acceptance of hazards.

McCullar: I'd like to talk for a minute about risk acceptance. We have commanders at all echelons who state that mission accomplishment comes first and that all risks are acceptable. We hold the view that risks can be minimized and that mission accomplishment must be balanced with full consideration for safety. What risks are acceptable, if any?

Ball: Let me build up to an answer by discussing a very earthy aspect of system safety; namely the acceptance of a new facility. For example, in testing the main engines for the space shuttle transportation system we're working with high pressure hydrogen. Fifteen thousand pounds per square inch is obviously a very dangerous thing to work with and there's very little experience in working with pure hydrogen at these pressures.

Overhead exterior view of space station taken from command module. Ocean is in background



There's no question that the top managers have to make decisions. The first thing that the boss has to assure is that all the relevant data has been generated. It would be irresponsible to go ahead and make a decision in the absence of data. This is a fairly obvious type of responsibility. But the staff man's job again is to make sure that all the data has been generated.

The go/no-go decision—this is the moment of truth for system safety. Question one: Have all the hazards been identified? Question two: Has all the data relative to these hazards been made available? Question three: Have the best technical people prioritized them? This is one of the essential system safety techniques of prioritizing in terms of probability of occurrence combined with the seriousness of the consequence of an accident. We have a rather formal system. We will take a viewgraph and project it on the screen and it will say that, for example, I, having studied all the facts, recommend acceptance of the residual hazards. This viewgraph is signed. Next, the chief engineer or the general manager of the contract can sign. A senior commander can have his next subordinate commander put such an acceptance of responsibility on the screen. This is what we do before all manned space flights. We sign. We put our signatures up there on the screen.

McCullar: The Army could benefit from a similar system where those in command sign as having properly discharged their safety obligations. Commanders and supervisors, including NCOs, have very high responsibilities with regard to aviation operations. Are there any words of wisdom you can pass on from your experience with manned space operations just from a standpoint of logic or discipline concerning evaluating calculated risks?

Ball: Let me try and answer that question with an analogous situation. After the Apollo fire, Mr. William Allen, who was president of The Boeing Company, asked, "Who is assuring that I, as president of the company, have done everything that I should to assure the safety of our products relative to the Apollo program?" So I was put in charge of a team for 3 months of intensive work. Twenty-one of us sought to assure the president of the company that everything he, as president, could do had been done. More specifically, we asked, has everybody working on the program done all they could to help identify hazards? In Dr. Low's words, have all the right questions been asked? Then, for each identified hazard, has every reasonable control been applied?

FIRST, CATCH THE RABBIT

System safety is an overall management technique that must ask, is the quality control system adequate for safety? Is the maintenance system adequate for safety? It isn't just one of a group of engineering techniques. It is an overall discipline with, of course, a single thought in mind, namely, the prevention of accidents. The more tangible a characteristic the easier it is for a manager or commander to assure its achievement. Consider the weight-lifting capacity of your heavy lift helicopter. That's a very real and tangible thing. But safety is very intangible. This puts a bigger strain on management. To assure the achievement of safety, I think, is the highest challenge to the management skills.

McCullar: I want to raise this thought for discussion. Command supervision, really the lack of command supervision, is one of the 10 cause factors we carry in our accident findings. In the 12-month period ending December 1972, command supervisory error was listed as a cause factor in only 17.5 percent of our accidents, and in the 12-month period ending December 1973, it had gone down to 13.0. I have heard you state that all mishaps can be laid at the feet of management. Can you explain our low showing on supervision as a cause factor?

Ball: I think that management is sometimes reluctant to accept even partial responsibility for accidents and there are causes for this. The reason that a supervisor very often doesn't write down supervisory error is not really ill will. He really doesn't understand what supervisory errors are. I think in many cases, if he really understood, he might come through and say, "Yes, indeed, there was a supervisory error." In other words, I think supervisory errors are more frequent than the record shows. I think one of the main reasons isn't management delinquency. It's a lack of understanding. And we can correct this by teaching. Then you say, "Well, what do you teach?"

One of the things you've got to teach is that each commander must know his people. He should have a sympathetic relationship with them, but should also know their strengths and weaknesses. I think this is just basic. You've got to know this to help them. You've got to know this to anticipate the mistakes they may make. It's the same principle with a ship captain at sea. You can say it's not fair to blame him if the navigator puts the ship on a sand bank. But if he didn't know his navigator and know his potential for error, that is where he failed in his responsibility as a commander. Let me give you an example.

Quite some years ago a Minuteman missile was launched from Cape Canaveral. It went off course and had to be blown up by range safety. Fortunately, the tail end of the missile fell on the beach and we recovered it. The missile is steered by hydraulic controls over the nozzles. We steer the missile by turning the nozzles. It turned out there was a clevis and we found that the pin that was supposed to go through the holes in the arms wasn't through. The steering mechanism just wasn't connected. The engineering mind would immediately say, "There's the problem. The clevis pin was not through."

Let's carry this further. We had a very fine manufacturing records system. We were able to identify the mechanic responsible for assembling this pin in a rather inaccessible position. And he had signed, "Yes, I have done this manufacturing operation." We found the quality control man who said, "Yes, I have inspected this assembly and it is correct." It turned out that both these people had been dismissed from the company because they had a history of emotional instability. Managers had hired those people and before they really knew their background, they had put them to work. They had put them to work on a safety critical item.

This missile came down on the beach. It didn't kill anyone, but public safety was involved. There was a management system breaking down. Here the supervisory error was in not screening the people. So the supervisor is responsible for knowing who he is hiring, for training them, for motivating them, and then for supervising them—having surveillance over them. We do need to teach all our managers the importance of these things before they assign tasks where human error could cause an unsafe condition. I just don't think we're teaching clearly enough this relationship between what it means to be a supervisor and the possible contribution to an accident.

There's another reason for management not recognizing supervisory errors. I have worked with company senior vice presidents who still thought in terms of the hardware. They were still engineers at heart and they would always look to the hardware. This is just the nature of the engineering mind, even when you get to be a company vice president or com-

mander. You look to the hardware instead of applying the scientific method to management analysis in terms of the controllable activities of people. The basic thesis is the manager cannot change the laws of physics. He cannot change the laws of chemistry. The only thing he can change is the behavior of people. This type of analysis needs to be taught. It needs to be taught as part of becoming a commander —the ability to analyze in terms of the controllable activities of people.

McCullar: I have noticed that NASA places a great deal of emphasis on communication between employee and supervisor and on a program of general safety awareness among all its people. One example that comes to mind was brought out during the system safety symposium last summer. A workman had dropped a paint brush into a fuel tank. He reported it and it took 2 weeks to disassemble the tank and retrieve the paint brush. Yet he was praised rather than fired because of his good record and the fact that he reported an error on his part which could have led to catastrophic consequences in flight. There was a lot of publicity given to his act, which showed that management and labor were mutually supportive of the safety program.

Ball: Motivation is an extremely vital part of safety achievement. There is a tremendous interest in employee motivation today. Terms like "participative management" are used. You probably know that at the beginning of the century, Taylor [Frederick Winslow Taylor], the father of industrial engineering, said, "Look, your employees are uneducated and ignorant. Simplify the tasks. Develop an assembly line and have this man turn this bolt." Task simplification. It worked. It was one of the keys to mass production. There's now a worldwide reversal of this principle. It is felt that employees at all levels are capable of thinking and you need them on the team. This is very, very true in the case of hazard control. So we could make a whole interview on the role of motivation. But let me say that, in NASA, it is recognized that the motivation to communicate upwards is vital to the safety program and motivation is part of the safety program. The Army has motivation in many areas. But in our case, the relationship

Extravehicular activity practice helped eliminate human errors during space missions

with safety is so primary that this is where we begin our motivational program. We link it to safety.

McCullar: Can you relate any specific examples of the benefits NASA has derived from the various system safety programs you've been involved with?

Ball: Yes. Let me precede this by saying there are three basic methods of hazard identification. One is a method where you start with an energy source and you ask, "What could happen to cause an accident?" Another is the reliability technique of failure mode and effect analysis where you start with known modes of failure of a component, such as a pressure regulator failing to open, and ask, "What would be the effects, particularly the safety effects, if this component fails?" The third basic technique for hazard identification is the human error, where you ask, "If the pilot didn't do this or didn't do that, what would be the effect on the system?" NASA has benefited from formalizing analysis in all three areas.

I was in Moscow when the cosmonauts had just broken the endurance record for time in orbit and I found myself visiting one of the Russian factories and offering a toast to their great success. I left the next day, and the next day the cosmonauts died. They died from anoxia, the loss of oxygen. We've learned since that there was a relief valve which had not been adequately tested for the shock from separation of two segments of the spacecraft, and it came open. The cosmonauts apparently thought they had an attitude control problem and before they could do anything to correct the relief valve, they died. Here was a case where the hazard was known but control was not accomplished.

In the Skylab program, we went into a tremendous review of every possible way in which the cabin atmosphere could be lost. Remember that our astronauts were working in shirt sleeves and not in suits and, therefore, loss of cabin pressure would kill them. We went through intensive hazard analyses, starting with the known hazard—lack of oxygen—and looking at everything that could cause it—faulty welding, faulty rivets, a window seal leaking, a valve coming open, a human error where a valve should have been in the closed position but was left in the open position. I am sure that we contributed to the safety of Skylab enormously by this formal system safety analysis of the possibility of loss of the atmosphere.

In the human failure area we've had quite a few cases of errors, but the possibility of these errors have been anticipated and, in general, ground control has been able to immediately recognize an error. This happened on one of the landings on the moon where, I think, a urine dump valve was left open overnight. Ground control was monitoring and they were able to wake the astronauts and say, "Look, a human error has been committed. Get up and close that valve." Formalized analyses of these three types, followed by system engineering, has been, I think, a key to the success that we've had. It has been system success even in the presence of component or human failure.

McCullar: Over the years, about 70 percent of our aviation mishaps have cited human error as a cause factor. In NASA's experience, how often does the human error crop up?

Ball: Let me first comment on this term, "human error," which is in standard usage. "Human error" is used to describe errors by maintenance or operating crews. It seems to deny that the designer is human, because design errors are not included. The term really ought to be support or operation error because most designers are human also. I would say, because the so-called human errors occur late in the development program, they attain great visibility. You could get the impression that they are a larger percentage of the total than they really are because many of the design and manufacturing errors that could cause accidents occur years before and they get picked up in qualification tests, design reviews and system tests. So, I would say that when you get toward the operational phase the human errors are perhaps 50 to 70 percent of the total. But during the course of the overall development, I doubt if they'd be more than 10 or 20 percent.

McCullar: At what point is the crewmember considered to be a part of the total overall system?

Ball: From the very beginning. There's a system engineering technique which we call function assignment analysis. This is used in military systems a great deal. You take a function such as attitude control at atmosphere reentry. You could have this done, like a pilot landing an airplane, by human control. You could have it done by onboard automatic controls. You could have it done by ground control. The function assignment analysis tells to which of these three types of controls we can best assign this func-

tion. The early system design decisions depend a great deal on analyzing the probability and consequence of human error.

McCullar: In Army aviation there are several new things going. Some of them are old things, just called by different names, perhaps. I refer to nap-of-the-earth flying. This is flying helicopters literally among the trees—all caused by the antiaircraft threat. We are primarily concerned right now with NOE daytime visual conditions. We are headed toward the time when we'll be flying NOE night formation in instrument conditions. From your experience in the manned space flight program, have you ever observed man being loaded with tasks to the point that he is just incapable?

Ball: Yes, indeed. This is a very real concern of safety and a great deal of system safety is concerned with human capability analysis. In the system engineering process you first define the mission, such as flying NOE as you've just mentioned. Then you come to the critical function associated with the mission. Immediately, system safety comes in and the first thing it does is to identify this "safety critical function." This is different from reliability. You can't do a reliability analysis until you've designed some hardware. You can do a safety analysis much earlier and it takes the form of recognizing critical functions. Take fuel loading, for example. You know very well there's going to be a fuel loading operation before you've designed anything. It's inherently a hazardous function. And so your hazard identification list begins with identifying "safety critical functions."

McCullar: COL Buzz Aldrin's book, *Return to the Earth,* gives some insight into the tremendous amount of rehearsal that goes on for some of the human tasks in space. He cited an example where they did their extravehicular activity practice under water to simulate the zero g gravity field. Have you found that this sort of rehearsal has helped eliminate human error downstream toward the end of the development program?

Ball: Yes. I have been at most of the debriefings of the astronauts in the last few years and without exception they have paid tribute to the tremendous amount of practice, including that in what we call the "neutral-buoyancy tank." This is a very large tank in which a mockup of the complete Skylab system was placed. In fact, in the rigging of the sun shade which helped save the Skylab mission, the astronaut said that the only operation that gave him real trouble was putting together the segmented poles. That was the one thing he hadn't practiced in simulated zero g. It appeared to be so simple—just putting one piece into the other. But they were stacked in a way that you had to break away the individual pieces before you assembled them and once you had broken the seal that was it. So any practice would have been destructive.

McCullar: We've talked quite a bit about supervisors, supervisory functions and management. For our purpose in the Army, can we not fairly equate these functions with leadership in command?

Ball: Yes. In several ways. You'll never acquire safety just by sitting back in your office and issuing policies and directives. Without the element of personal inspiration, I don't think you're going to acquire safety in any phase—development, maintenance or operations. The safety attitude must start at the top and go down through the entire chain of command. Along with leadership goes a moral obligation, an obligation which is especially binding in areas where human life may be placed in jeopardy. Those charged with the responsibility for safety do not necessarily pay the consequences when safety management breaks down.

This immediately brings us face to face with the moral side of safety because the commander is responsible for what his people do on the job. The moral responsibility for injuries or deaths that may result from a lack of supervision rests squarely with the commander. I think the moral obligations are these—first, that everything that could have been done to identify and evaluate hazards has been done. It's immoral to expose a man to hazards that haven't been evaluated. Having evaluated them, then the next thing you're morally responsible for is to ensure that everything that can be done to reduce and control the hazards has been done. These are command responsibilities. The commander must face the fact that he has a moral as well as a tactical responsibility and he must find a way to effectively discharge both of these obligations.

McCullar: Thank you, Dr. Ball, and please give my thanks to Dr. Petrone for making you available to us for this interview.

Ted Kontos
Publications and Graphics Division
U.S. Army Agency for Aviation Safety

USAAAVS

When you fail to check weather reports or to heed severe weather warnings, and you fly into the teeth of a storm . . .

DON'T EXPECT MIRACLES

THE U-6 BEAVER NOSED over at 7,000 feet and headed straight for the ground. At the controls was a student pilot. Beside him sat the instructor pilot (IP). Behind them were two students. This maneuver was not part of the training scheduled for this early summer afternoon. Nor was it authorized by the dash 10. Neither were the actions of the IP who immediately retarded the throttle, cut the mixture and pulled the prop to high pitch as the aircraft screamed downward and the airspeed climbed to 195 miles per hour.

Only moments earlier, the aircraft was homeward bound from a routine instrument training flight. Barely 2 minutes from its home station, it entered a solid overcast. The sky was dark, but only light rain and mild turbulence were encountered. Although scattered thunderstorms were reported in the area, none were deemed particularly severe or concentrated. As the student at the controls began a turn, the storm hit the aircraft full force, flipping it almost completely over and tumbling all gyro instruments. The nose dive followed. By sweeping the panel clean, the instructor was able to reduce the airspeed to approximately 85 to 90 mph but could not regain aircraft control. Then, the nightmare developed. The storm lifted the aircraft (with all power off) to 11,000 feet, immediately dropped it to 4,000 feet, then shot it back up to nearly 7,000 feet. Heavy rain, light hail and cross drafts accompanied the sudden changes in pressure. While the IP and the student in the cockpit fought to regain aircraft control, the two students in back could do nothing more than hope for a miracle. They got two.

With the same suddenness that had sent them careening into a dive, the storm tossed the aircraft, three-quarters inverted, out of its center into clear air ahead of the roll cloud approximately 2,800 feet above the ground. The IP righted the aircraft, restarted the engine, cancelled his IFR (instrument flight rules) flight plan, and after reporting the severity of the storm, flew north until he found a weak spot in the storm system, made a VFR (visual flight rules) penetration and landed safely. The second "miracle"? Despite the grueling ordeal the aircraft had been subjected to, inspection revealed no structural damage. A point worth noting is this storm had developed to major proportions while between two Federal Aviation Administration (FAA) weather reporting stations and had gone unnoticed by both.

In contrast to this inadvertent encounter, a UH-1B pilot flew into a thunderstorm area witnesses described as "the worst weather in 30 years, with terrible lightning and thunder." The main rotor separated and the helicopter crashed, killing both occupants. The pilot was not instrument rated.

While both of these occurrences took place several years ago, they still serve as effective reminders of nature's unpredictable and awesome power—a power we cannot buck and expect to emerge unscathed. And it doesn't matter whether we deliberately provoke the encounter or unwittingly find ourselves involved.

We have studied the weather for centuries; but we have yet to find a way to control it. We have continuously improved our equipment; still, the strongest aircraft built cannot withstand the full impact of tornadic forces often generated by thunderstorms. We have developed electronic devices that can detect

and locate areas of severe weather, and we have even equipped some of our aircraft with these devices; but they cannot be depended upon to locate all dangerous areas or to guide us around them with assured safety. Where does the answer lie? And with so many other problem areas, why should we emphasize those associated with thunderstorms? This latter question is more easily answered.

According to one source, about 44,000 thunderstorms churn daily over the earth's surface. At least 1,800 of these are in progress at any given moment, discharging lightning flashes at the rate of 100 every second and generating heavy precipitation, hail and violent winds. While some thunderstorms are associated with frontal systems, others are not. Also, their incidence increases during the summer months, with certain areas of the U. S. averaging 30 days of turbulent weather during this single season. This season is here.

The best solution is the most obvious one—stay away from thunderstorms. Unfortunately, this is not always possible, and the decision as to what a pilot should do in any given situation depends on his knowledge, experience, skill, technique and on the type of equipment he is operating. Of these, the experience and skill level of an individual cannot be changed at any given time and varies from one person to another. Since he is the best judge of his capabilities and limitations, the pilot must make this evaluation. Likewise, equipment cannot suddenly be transformed from one type to another, and a pilot's evaluation must also include the capabilities and limitations of the aircraft he is flying. This leaves knowledge and technique as the two prime weapons at his disposal.

Knowledge. A thunderstorm consists of one or more cells which are constantly changing. Each cell is an independent unit and develops through three stages: the growing stage, the mature stage and the anvil stage. In their horizontal, oblong formation, thunderstorm cells can extend from 1 to 5 miles in diameter and reach a height of 67,000 feet. During the growing stage, air rises rapidly, often reaching the velocity of more than 60 mph. During the mature stage, air currents both rise and descend. The anvil stage produces weak downdrafts throughout the cell. As a thunderstorm progresses, new cells develop as old ones die out, and a cell's life is fairly short, usually less than 1 hour. The greatest turbulence in any particular cell occurs at the end of the growing stage and peaking of the mature stage. Cell turbulence is usually least below 10,000 feet and greatest between 14,000 and 20,000 feet.

As a thundercloud develops, it forms puffy, rolled-looking sides as it extends upward. Through growth and change, its top spreads out in an anvil shape. Direction of this horizontal anvil indicates the direction of the storm. One positive indication of a thunderstorm is the squall or roll cloud that extends downward from the main base of the storm. This highly turbulent cloud is located along the front and bottom of a violent thunderstorm. Its appearance means plenty of severe weather lies within the storm. Because winds are gusty and strong below the storm cloud, usually blowing up and into the storm from in front and down and out of it from behind, an aircraft flown too close to the roll cloud could be inadvertently hurled into the storm. The possibility of this happening is greatest at night or when the roll cloud is hidden behind other clouds surrounding the storm. While radar can provide the pilot with a picture of what lies ahead, it is important to remember that clear air outside the clouds can contain severe turbulence that even radar cannot detect.

When thunderstorms are associated with a frontal system, they may be organized in long bands that progress ahead of the front. These are commonly referred to as squall line thunderstorms. Horizontally, they may extend a hundred or more miles while reaching altitudes of 60,000 feet or higher. These thunderstorms may be imbedded in stratified and multiple cloud layers and not be visible.

Sometimes a thundercloud will tilt with the wind. Clear air under a tilted thundercloud or between thunderclouds slanting toward each other can be especially turbulent and may contain hail—another hazard associated with thunderstorms. At present, we have no positive means of recognizing or forecasting a storm that will produce hail. It is a safe bet, however, to always assume that hail will be present at some place and time within a thunderstorm. Although hail encounters are generally of a short duration, they can inflict severe damage on an aircraft.

While lightning seldom poses a direct threat to an aircraft, it can be highly disconcerting, particularly at night. It can cause momentary blindness to the crew, and erroneous indications of such navigational aids as nondirectional beacons.

Airmass thunderstorm cells build up over land during the heat of the day and usually break in late afternoon or early evening. However, either airmass or frontal type thunderstorms may be encountered at any time.

Elementary? Yes. But while this information presented in capsule form is basic to every pilot, it also serves as the basis for our present regulations governing flight procedures to be used when in the vicinity of thunderstorms—procedures that, if followed, should keep us out of trouble. The question is, will they? For example, if we

DON'T EXPECT MIRACLES

should skirt a thunderstorm by flying around the backside while staying in clear air at least 5 to 20 miles away from cells, in accordance with present regulations, will our safe passage be assured? Modern research indicates that it may not, for this is the area where one of the greatest hazards to aviation exists —the unseen tornadic vortex.

Observations and studies completed more than 6 years ago indicate that vortices, or tubes, of tornadic or near-tornadic intensity may be encountered in and under innocent-looking lines of clouds extending from thunderstorms. These vortices are invisible and may exist as far as 20 nautical miles from the associated thunderstorm. Because lightning and air turbulence in their vicinity may be light or moderate, they cannot serve to indicate the presence of vortices. Sometimes their presence can be detected by noting dust-whirls over land areas or swirls on the surface of water. These tubes may extend to great heights within flanking cloud lines, often to 18,000 feet mean sea level and sometimes as high as 35,000 feet near the thunderstorm. Neither the tubes nor the embedding clouds can be reliably detected on airborne radar, although ground radar may detect the cloud line if it is within 30 miles and no heavy precipitation accompanies it.

Another important aspect of this hazard is the great distance from the associated thunderstorm at which these tubes may exist. Further, it appears that these tubes occur more frequently than do visible tornadoes. Since no completely reliable local indications of the existence of vortices presently exists, avoidance must be based on knowledge of the presence of thunderstorms with which these cloud lines and tubes are often associated and flight procedures to avoid the cloud lines. A general rule is to suspect tornadic vortices anytime a thunderstorm forecast includes the possibility of tornadoes, whether the thunderstorm is of an airmass or frontal system type.

In an article ("Advance of Tornadic Turbulence") published in the September 1968 issue of the AVIATION DIGEST, the author, Dr. Fred C. Bates, estimated that the probability of encountering these tornadic vortices in random flight below 35,000 feet in the United States east of the Rocky Mountains is approximately once every 3,000 hours when no avoidance attempt is made. He further estimated that the probability of this encounter being of a catastrophic nature was one chance in eight. Consequently, if no avoidance is practiced, a major accident can be expected in 24,000 hours of flight. However, skill in avoidance can increase this "waiting time" to nearly one-fourth million hours of flight.

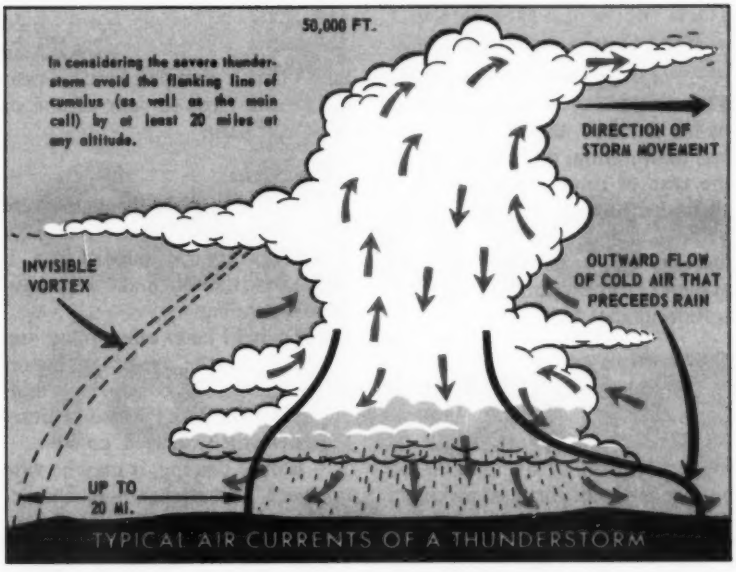
While these observations are based on research conducted several years ago, they have been substantiated by more recent studies. The following is quoted from "The Invisible Menace," by Captain Ted Janczarek (CAL), (July 1973 AIR LINE PILOT): ". . . Scientists and researchers have reason to believe, and are finding more evidence that simply avoiding a severe thunderstorm by 20 miles, or more, despite the fact the aircraft is in clear air environment, does not ensure a safe flight. In fact, a number of incidents involving aircraft flying in clear air or through clouds showing no radar echo has proved extremely hazardous.

"It is believed the line of innocent-appearing clouds with little or no radar return on the up-relative-wind flank of certain thunderstorms, and within, contain a network of tornadic tubes or vortices. A review of observations has revealed the frequent presence of this hazard. . . ."

Numerous examples of aircraft inadvertently encountering these tubes have been documented. In one, an airliner was climbing out through a saddle between two cells at 18,000 feet when it encountered what is believed to have been the top of a horizontally oriented tornadic tube that existed between the two cells. The airspeed dropped to zero and the aircraft was nosed down. In the absence of relative flow for lift but undergoing acceleration in the vortex flow, the aircraft responded in a high velocity dive. Fortunately, it cleared the vortex in its forward motion and as the airspeed approached Mach 1, the captain reversed the engines in an attempt to slow the aircraft and, luckily, was able to save it. Other pilots have not been as fortunate.

Today, scientists appear to agree that tornadoes occur more often on the flanks of severe thunderstorms some distance away from heavy rain and lightning, and near the trailing edge of a squall line, and that the greatest hazard lies on the flank of severe thunderstorms where invisible tornadic vortices are occurring below the base and within innocent-appearing clouds. These vortices produce no radar returns and usually have a common base with the thunderstorm at distances that range more than 20 miles from the rain and lightning beneath the storm. The only indicator to alert the pilot to this invisible destructive force is his knowledge of how near a storm cloud or system he can expect to encounter a tube. This bit of knowledge also provides him his only defensive action—avoidance.

Technique. Since most Army aircraft are not designed to operate at high speeds and altitudes or to withstand the stresses imposed by high positive and negative g forces, and since few are outfitted with airborne weather radar equipment, *the only safe policy, regardless of the experience and skill level of a pilot, is to avoid flying into severe*


50,000 FT.
In considering the severe thunderstorm avoid the flanking line of cumulus (as well as the main cell) by at least 20 miles at any altitude.
DIRECTION OF STORM MOVEMENT
INVISIBLE VORTEX
OUTWARD FLOW OF COLD AIR THAT PRECEEDS RAIN
UP TO 20 MI.
TYPICAL AIR CURRENTS OF A THUNDERSTORM

Note the wedge of rain-cooled air that pushes along the ground ahead of the storm. It is this rush of air that creates the greatest hazard to aircraft maneuvering in the vicinity

weather. Think of it as a form of evasion and escape. The tactics required can be classified under the four headings of intelligence, evaluation, decision and operations.

Intelligence signifies the gathering of information and is the principal safeguard against thunderstorm flying. It begins with a complete and thorough preflight weather briefing, followed with constant in-flight weather observations supplemented with radio weather advisories along the route. Clouds are excellent signposts. Their type, number and size, along with any change in form and rate of change all provide the pilot with important clues. Billowy, puffy cumuli can increase in number, grow and fill the spaces between them in short order. Similarly, a towering cumulus in the distance can become a raging thunderstorm in a matter of minutes.

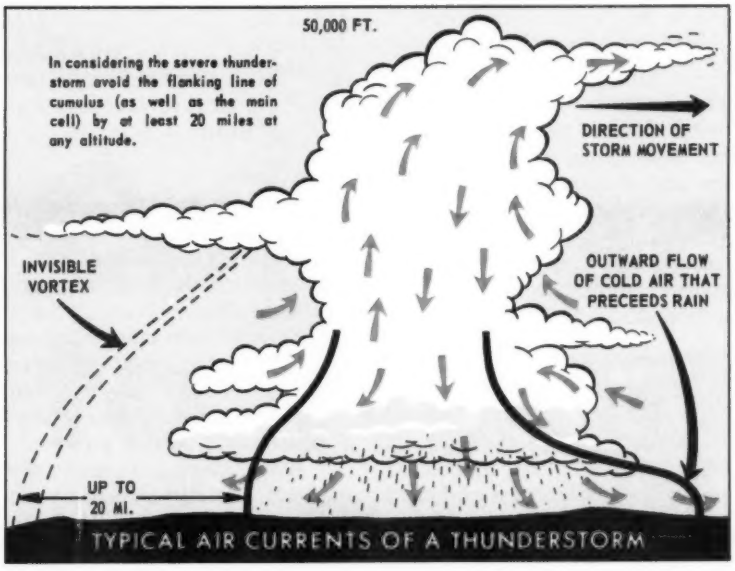
Next we must evaluate not only the weather information we have collected but also our capabilities and those of our aircraft. Are we qualified to go on instruments if we have to? If so, is our aircraft fully instrumented? Does our information simply indicate that we can expect "bumpy" flight ahead, or does it predict the possibility of severe turbulence? The more complete our information is and the more thorough our evaluation, the easier it will be to reach the best decision—our next step.

Deciding what to do is not always easy. Sometimes arriving at a decision can be made less difficult by considering the alternatives and eliminating any we know we shouldn't follow. For example, we know not to attempt flight over any thunderstorm; and we know that trying to slip under the base of one, where violent downdrafts can extend to 300 feet off the ground and can be accompanied by severe crosswinds and even hail, could prove disastrous. If our decision might possibly force us to attempt either of these no-no's, it is the wrong decision. What makes reaching the right decision even harder is that ego and pride become involved. We don't want to be like a rookie policeman who prematurely unholsters his weapon when no such drastic action is indicated. At the same time, it could prove disastrous for him to wait too long before readying his weapon should the situation turn out to be a serious one.

The most important single criterion you can use in arriving at what is best can be satisfied by asking yourself a simple question: "Does my decision rely, in part, on the element of *chance* to ensure my safety?" If your answer is yes, make another decision. Based on your knowledge and experience, if you can say with assurance, "I'll be past these cloud formations and eating lunch at the operations cafeteria before the storm develops," then continue flight. But if your statement is any less positive, such as, "I *think* I can squeeze by these clouds before the sky caves in," then head back from where you came. The importance of your decision cannot be emphasized too strongly because if you are to head for an alternate field or to make a 180-degree turn, the time to do it is now—before you're caught inside a storm. Once trapped, you are committed to continue. There is no turning back. Don't let false pride force you into any situation you may not be able to handle.

Once you have determined your action plan, put it into operation. If you decided on a 180, head back. If you are intent on circumnavigating developing thunderstorms, have at it, keeping in mind that "circumnavigating" means "going around"—not flying over, under or through them.

What if the thunderstorm you are circumnavigating turns out to be a severe one containing the elements that produce tornadic tubes or vortices? Keep the following in mind: Not only is the distance you maintain from such a storm important to your safety but also the direction of avoidance. Recom-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TYPICAL AIR CURRENTS OF A THUNDERSTORM

Note the wedge of rain-cooled air that pushes along the ground ahead of the storm. It is this rush of air that creates the greatest hazard to aircraft maneuvering in the vicinity

weather. Think of it as a form of evasion and escape. The tactics required can be classified under the four headings of intelligence, evaluation, decision and operations.

Intelligence signifies the gathering of information and is the principal safeguard against thunderstorm flying. It begins with a complete and thorough preflight weather briefing, followed with constant in-flight weather observations supplemented with radio weather advisories along the route. Clouds are excellent signposts. Their type, number and size, along with any change in form and rate of change all provide the pilot with important clues. Billowy, puffy cumuli can increase in number, grow and fill the spaces between them in short order. Similarly, a towering cumulus in the distance can become a raging thunderstorm in a matter of minutes.

Next we must evaluate not only the weather information we have collected but also our capabilities and those of our aircraft. Are we qualified to go on instruments if we have to? If so, is our aircraft fully instrumented? Does our information simply indicate that we can expect "bumpy" flight ahead, or does it predict the possibility of severe turbulence? The more complete our information is and the more thorough our evaluation, the easier it will be to reach the best decision—our next step.

Deciding what to do is not always easy. Sometimes arriving at a decision can be made less difficult by considering the alternatives and eliminating any we know we shouldn't follow. For example, we know not to attempt flight over any thunderstorm; and we know that trying to slip under the base of one, where violent downdrafts can extend to 300 feet off the ground and can be accompanied by severe crosswinds and even hail, could prove disastrous. If our decision might possibly force us to attempt either of these no-no's, it is the wrong decision. What makes reaching the right decision even harder is that ego and pride become involved. We don't want to be like a rookie policeman who prematurely unholsters his weapon when no such drastic action is indicated. At the same time, it could prove disastrous for him to wait too long before readying his weapon should the situation turn out to be a serious one.

The most important single criterion you can use in arriving at what is best can be satisfied by asking yourself a simple question: "Does my decision rely, in part, on the element of *chance* to ensure my safety?" If your answer is yes, make another decision. Based on your knowledge and experience, if you can say with assurance, "I'll be past these cloud formations and eating lunch at the operations cafeteria before the storm develops," then continue flight. But if your statement is any less positive, such as, "I *think* I can squeeze by these clouds before the sky caves in," then head back from where you came. The importance of your decision cannot be emphasized too strongly because if you are to head for an alternate field or to make a 180-degree turn, the time to do it is now—before you're caught inside a storm. Once trapped, you are committed to continue. There is no turning back. Don't let false pride force you into any situation you may not be able to handle.

Once you have determined your action plan, put it into operation. If you decided on a 180, head back. If you are intent on circumnavigating developing thunderstorms, have at it, keeping in mind that "circumnavigating" means "going around"—not flying over, under or through them.

What if the thunderstorm you are circumnavigating turns out to be a severe one containing the elements that produce tornadic tubes or vortices? Keep the following in mind: Not only is the distance you maintain from such a storm important to your safety but also the direction of avoidance. Recom-

mended leeway from the main cell is *20 miles minimum at all storm altitudes. In addition, avoid the flanking line of cumuli by at least 20 miles at any altitude*. And never penetrate or fly below the base of a line of clouds aligned on the flank of a thunderstorm and on a common base with it when there is any reason to suspect the existence of tubes or vortices. Don't let the relatively mild appearance of the flanking line of cumuli, as compared to the main storm, fool you into thinking that no hazard exists.

There you have it—the steps you should use as a guide when confronted with severe weather problems. What about those procedures listed in the respective dash 10 for each type of aircraft? They are most important, but we must understand one thing clearly: While they are the best procedures to use when caught in severe turbulence, they should in no way be interpreted as an endorsement to fly through any *thunderstorm*. They cannot assure your safety. In brief, they can be divided into three areas: aircraft preparation, storm penetration and followup or after flight through a turbulent area.

Preparation

Ready your aircraft for thunderstorm penetration before entry by doing the following:

• Set instrument and cockpit lights to full bright.

• Turn on pitot heat and anti-icing systems.

• Check cargo (if applicable) for security and notify crew and passengers of the possibility of encountering severe turbulence.

• Lock shoulder harness and direct crew and passengers to secure restraint devices.

• Disengage all ASE equipment.

• Turn off radio equipment not needed.

• Adjust power settings and reduce airspeed to that recommended by the dash 10, usually 20 percent less than normal cruising speed. In the case of rotary wing aircraft, a slight increase of operational rpm will make the blades more rigid and increase the stability of the rotor system. Trim the aircraft for penetration airspeed.

Penetration

• If you have a choice, establish a penetration altitude between 4,000 and 6,000 feet above the highest terrain. This altitude has been found to be the least turbulent. It also is high enough to take care of downdrafts. Hail and ice as well as more severe turbulence are found at 10,000 to 12,000 feet and these altitudes should be avoided.

• Keep power settings as constant as possible. Airspeed indicators often give false readings in vertical drafts and heavy rain.

• If possible, select the heading that will take you through the storm in the least amount of time. To help determine your best heading, use all available indicators such as radar, lightning flashes and storm appearance. Establish your heading and maintain it. Don't turn around.

• Keep the wings as level as possible to aid in maintaining your heading.

• Concentrate on maintaining a level attitude. Avoid "chasing" the airspeed and trying to correct for altitude lost or gained due to up or down currents unless it is absolutely necessary to clear obstructions.

• Avoid any unnecessary maneuvering, and be gentle and easy on the controls.

• Finally, because of high, unpredictable gusty surface winds in addition to possible hail, rain and poor visibility, never try to land or take off if a thunderstorm is near the field or close to your takeoff or approach path.

After flight

• Following flight through severe turbulence, check your aircraft for possible structural damage and, if deemed advisable, make a precautionary landing.

• To help keep other pilots out of trouble, make an inflight report to both air traffic control and military METRO (Pilot-to-Military Weather voice call), if possible.

• Before landing, it may be wise to check aircraft handling characteristics in the landing configuration, making sure you don't allow the aircraft to stall. If runway length is ample and other conditions are satisfactory, consider adding a few knots to the normal approach airspeed.

• Write up any damage in the DA Form 2408-13 and, if warranted, request a complete check of your aircraft by a qualified maintenance activity.

Granted, while procedures outlined are not all-inclusive, they serve as a guide to help ensure your safety. Review and follow them, bearing in mind that the *only* recommended and safe policy when confronted with thunderstorms is to avoid them.

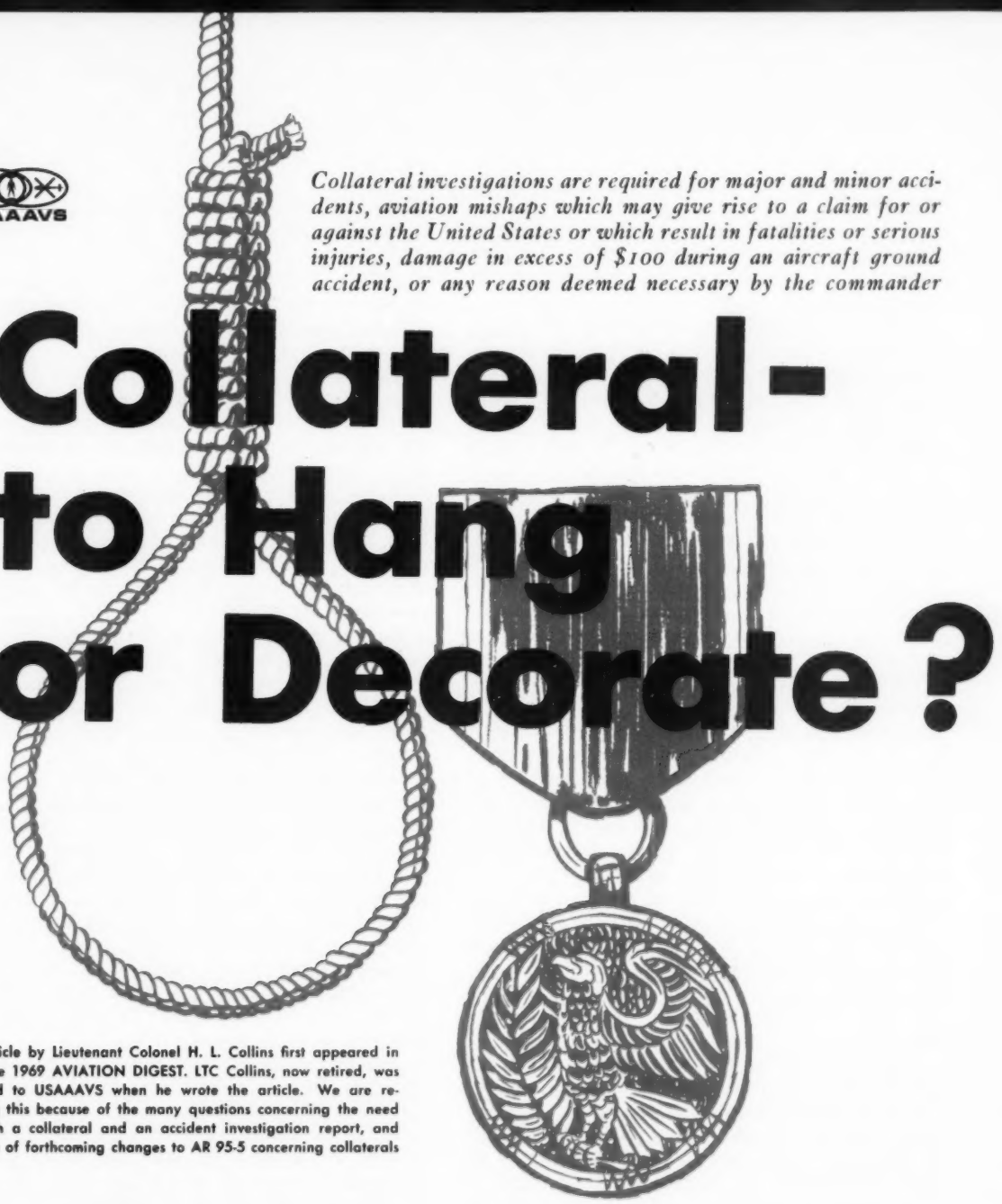
What about the fearless pilot who can handle any situation any time and who doesn't hesitate to tackle any storm? He might do well to recall the fictional lancer, Smedley, who heroically charged enemy artillery: And when the guns went silent and the smoke had cleared, there was Smedley . . . and over here was Smedley . . . and over yonder was Smedley. . . .

If you should be confronted with severe weather and you insist on jumping in, go ahead. It's your prerogative—but don't expect miracles.

USAAAVS

Collateral investigations are required for major and minor accidents, aviation mishaps which may give rise to a claim for or against the United States or which result in fatalities or serious injuries, damage in excess of $100 during an aircraft ground accident, or any reason deemed necessary by the commander

Collateral- to Hang or Decorate?



This article by Lieutenant Colonel H. L. Collins first appeared in the June 1969 AVIATION DIGEST. LTC Collins, now retired, was assigned to USAAAVS when he wrote the article. We are reprinting this because of the many questions concerning the need for both a collateral and an accident investigation report, and because of forthcoming changes to AR 95-5 concerning collaterals

CONSIDERABLE FOG apparently shrouds this dark and ugly term *collateral*. It is appropriate to spend a few words to clear away this fog and create a new outlook concerning the *collateral investigation*.

Let's first discuss investigations common to aircraft accidents within the military services. Each service has its own responsibilities relative to aircraft accidents. They may be called by different names, but they can be separated into two distinct categories, according to purpose:

- Accident prevention and safety.
- Determination of all facts and circumstances for reasons other than accident prevention and safety.

The accident prevention and safety investigation is technically called the U. S. Army aircraft accident investigation. (For the purpose of brevity, the aircraft accident investigation hereafter will be referred to as the "safety investigation.") It is a thorough and systematic examination and analysis to disclose all rele-

vant facts, conditions and circumstances associated with or surrounding each aircraft accident. It is conducted for the sole purpose of accident prevention (paragraph 7b, AR 95-30).

When an investigation is conducted for any reason other than accident prevention, we apply the general term *collateral* to describe this action being taken.

Collateral means side by side or parallel. Therefore, these investigations (chapter 8, AR 95-5), conducted for other reasons, and at the same time as the safety investigation (chapter 13, AR 95-5), are parallel to the aircraft accident safety investigation. This is the origin of the general and accepted use of *collateral investigation.* Presently, chapter 8, AR 95-5, covers collateral investigations. This chapter has been revised and changed to appendix VIII and should be available to the field in September 1974. Chapter 13 pertaining to safety investigations will be changed to chapter 12.

What other reasons might there be to require an investigation paralleling the safety investigation? To answer this question, we must understand the conduct of and restrictions placed upon safety investigations. The ultimate goal of each safety investigation is to uncover all cause factors surrounding a particular accident. Appropriate steps may then be taken to eliminate these factors and reduce the probability of recurrence of identical or similar accidents.

Quite a task, you say? Yes, but not beyond reason. With proper training of board members, command emphasis on the importance of finding accurate cause factors, and the timely and appropriate use of facilities and specialists at our disposal, a safety investigation can reveal all cause factors involved in an aircraft accident.

The factors causing an accident can be determined only if certain guidance is established concerning the manner in which this information is to be used. Paragraph 1-4, chapter 1, AR 385-40, explains the nature of information contained in a report of an aircraft accident investigation. It says, in effect, that the report is to be considered privileged, and its contents will not be released to the general public. It will be seen only by those persons needing the information for accident prevention purposes. It is for official use only. Claims for or against the government cannot be based on this report. The investigation report can in no way be used to determine negligence or culpability on the part of any individual directly or indirectly involved. It cannot become the basis of administrative or punitive action.

Why is it necessary to be so tight-lipped about the causes of an accident? Are we trying to protect our aviators or cover a goof-up? Not on your life! The answers become apparent if you imagine yourself in the position of a crewmember in, or a witness to, an aircraft accident. Consider how you would describe the series of events leading to an accident if you knew that your testimony could be used against you for administrative or punitive action.

Did you goof in any way? Heck no! While no sane person would come right out and lie about the situation, his testimony probably will become slanted, and certain relevant facts might well be overlooked under these circumstances.

Would you reveal improper techniques used by a fellow soldier, knowing this information might be used against him? Perhaps, but only with genuine reluctance. It would probably appear to the board as though they were pulling teeth to get any useful information from you.

Do you see the point now? Remember, the intent is to determine the facts surrounding the cause of the accident during the safety investigation. This is necessary to determine accident prevention measures which will prevent the recurrence of similar type accidents. And that's all we want to do!

Now, back to the original question about the reasons for other types of investigations. The first is to have information available about accidents which can be released to the public. As mentioned, information gained by the accident safety investigation cannot be released. The only information which can be released must come from other type investigations. This report should be completed prior to the safety investigation report and submitted through channels to the Office of The Judge Advocate General, HQDA (DAJA-LTD-G), Washington, DC 20310, for consideration prior to release.

Any aircraft mishap can cause damage to private property. The possibility always exists that a claim for damages may be filed against the government. All facts and circumstances concerning damage to private property (in excess of $25,000) must be documented for possible future use in a claims court. This type of *collateral investigation* is conducted in accordance with AR 27-20 for claims investigation. A similar requirement exists when an aviation mishap results in death or serious injury to any civilian or military personnel. Documentation is necessary for use in claims for or against the government. This is another type of *collateral investigation,* with the report going to The Judge Advocate General (TJAG).

Injuries and damages also can result during aircraft ground accidents; that is, when there is no intent to fly but the powerplants are in operation. A collateral will be conducted when damage is in excess

of $100 or there is a disabling injury to personnel.

Suppose an accident occurs in which it appears the pilot willfully violated regulations or was negligent in the performance of his duty. This sometimes happens. Some corrective action is necessary if we are to maintain standards of conduct within which we are to operate. Again, the *collateral investigation* must be the only basis upon which such action can be taken without compromising the contents of the safety investigation report.

AR 95-30 indicates such an investigation may be required when there is a need to provide official factual documentation of all matters pertaining to the accident which can be used in connection with any legal or administrative action. This just about sums up the position that all accidents need some documentation which can be used for purposes other than safety.

How about the conduct of these *collateral* or other types of investigations? Are there differences? Will the result be the same as in the safety investigation? AR 95-30 defines the limitations of *collateral investigations*. These are to be completely independent of and separate from the safety investigation. The report of any collateral investigation can be used for various administrative, disciplinary and litigation purposes. It *can* be used as a basis for fixing pecuniary liability, and may adversely affect individuals concerned. Conversely, collateral investigations also determine nonculpability which is important for clearing surviving crewmembers, establishing eligibility for death gratuities, etc. Since it can cause concern to the individuals involved, certain restrictions must be placed on the manner in which information is gathered.

First, the report of a safety investigation cannot be used in any other investigation. Witnesses who appeared before the safety investigation board also may be called by the collateral board. They cannot, however, be questioned concerning their statements or other matters presented during the safety investigations. Persons appointed to the safety investigation board cannot serve as members of a board conducting a *collateral investigation* of the same accident.

Although a member of the safety investigation board may be called before another board as a witness, he cannot be asked or required to divulge privileged testimony or his opinion based upon that testimony. Actually, any testimony gathered by the safety investigation board, in the interest of accident prevention, which could be detrimental to any person involved, is considered privileged testimony and cannot be divulged by any member of this board.

Under no circumstances can any person having knowledge of the substance of the safety investigation report be required to divulge the findings or recommendations to any other investigation board.

To avoid duplication of factual information, the collateral report can be supplemented by data such as photographs, teardown analysis of component parts, and fuel and oil analyses used in the safety investigation. However, the collateral board must obtain this information from the photographic and analysis facilities rather than from the aircraft accident investigation board.

It is not the intent to try to penalize every person who makes an error. Certainly, errors must be expected from human beings. Aviators are expected to exhibit the characteristics of normal, prudent individuals. When one fails to exhibit these characteristics through flagrant violation of policies and regulations, or complete disregard for safe operational practices and procedures, he can certainly expect a collateral board to point out such weaknesses and recommend appropriate corrective action.

Aviators aren't the only individuals who show undesirable traits. For example, let's look at a major accident in which the majority of the cause factors appeared to be pilot error. The commander threatened to have this pilot grounded permanently because of unauthorized low-level flying. In this case, the collateral was the only resource the pilot had to tell his side of the story, cross examine any adverse witnesses who testified under oath, challenge any board member for a just cause, such as prejudice toward any pilot involved in a crew error accident, etc. The pilot also had a right to defense counsel during the collateral proceedings.

Prior to this accident, the pilot had been under undue personal and physical stress. Although his commander was well aware of the pilot's personal problems and fatigue, he would not allow him adequate time to resolve his problems or get adequate rest. Nor did he recognize the pilot's problems as having a harmful effect on his flying ability. The commander placed mission accomplishment ahead of the well-being of his men. This pilot had flown excessive hours during the month before the accident, in addition to performing his other duties. The pilot could not be totally exonerated in this accident, but it was found that the commander was equally responsible for this accident.

The collateral board not only serves to protect the report of the aircraft accident safety investigation board, but serves to protect your interest when your interest deserves protection.

PEARL'S

Personal Equipment & Rescue/Survival Lowdown

Overwater Survival

Can you give me the dimensions and weight of the seven-man life raft and the weight and components of the individual survival kit?—CW3

The seven-man life raft, MRK 7, FSN 4220-245-7751, uninflated is 36 inches long, 15 inches in diameter and weighs 114 pounds. The inflated dimensions are 11 feet 10 inches to 12 feet 2 inches long and 5 feet 7 inches to 5 feet 9 inches wide, depending on the amount of air pressure used in inflating the life raft.

The individual overwater survival kit, FSN 8465-473-1863, weighs 28 pounds. TM 55-8465-214-10 provides technical information on the kit, its use and operation, and a listing of its components.

Life Raft Carrier

Could you give me a description of the CNU-7P backpack life raft carrier? I also would like to know if this carrier is available to the field and how to procure it.—CW2

The Army has on loan from the U. S. Air Force approximately 200 CNU-7P backpack life raft carriers. The CNU-7P will accommodate an LRU-3 or an LRU-4 one-man life raft. When the LRU-3 life raft is packed in the CNU-7P, the packed dimensions are 15 inches wide, 24 inches high and 2 inches thick. When the LRU-4 one-man life raft is used, the pack is thicker.

The CNU-7P life raft carriers were borrowed from the Air Force for use by aviation crewmembers of the 25th Infantry Division during overwater flight. The carrier is a U. S. Air Force item of issue and is in short supply. The one-man life raft is available through Army supply channels.

Fire Blanket

CTA 50-914 lists an item "Blanket, Fire, With Case for Wall Mounting, LN80556N." When trying to cross reference this line number in SB 700-20 for the FSN, this item could not be found. What information do you have on this item?—CW2

CTA 50-914 has been superseded by CTA 50-900, dated 15 November 1973. The fire blanket with case is listed in CTA 50-900, part B, page II-79, line item number 80556N. The letter "N" indicates the item is nonstandard and, therefore, would not possess a federal stock number or be listed in SB 700-20. Since the item is nonstandard, it must be purchased from a commercial source using appropriated funds. It is recommended that you visit your local purchasing and contracting office and review commercial vendor catalogues to determine whether a suitable item is available for purchase.

Prescription Glasses

I would like to find out exactly how many pairs of glasses with flight frames a person on noncrewmember flight status is authorized. I would also like to know what reference cites this policy. I am on noncrewmember flight status and wear prescription glasses. When I placed an order for two pairs of clear lenses and one pair of tinted lenses, my request was denied on the grounds that only persons on crewmember flight status are authorized their issue. This not only affects me but every other man on noncrewmember flight status.—SFC

AR 40-3, chapter 11, paragraphs 11-3g(3) and (4), dated September 1973, covers the authorization and issuance of aviation prescription sunglasses and aviation clear coated spectacles. The regulation does not authorize issue of aviation prescription spectacles to individuals in noncrewmember status.

If you have a question about
personal equipment or
rescue/survival gear, write Pearl
USAAAVS, Ft. Rucker, AL 36360
USAAAVS

USAASO Sez

The U. S. Army Aeronautical Services Office discusses

MANY U.S. ARMY and Army National Guard airfield facilities were constructed years ago under criteria for low and slow performance aircraft. Visual flight was the name of the game and obstructions such as water tank towers, hangars, power poles and roadways were placed close to runway and approach/departure zones to save construction cost and for facility service convenience or security. Aircraft parking areas were small and electronic Navaids did not exist.

Movement and operation of heavier, faster and a greater number of aircraft into these facilities over the years has sometimes resulted in crowded conditions which compromise ground and flight safety. This can be compounded when instrument procedure systems are added and the procedural criteria are compromised and/or waivered in order to do our flying thing. This may be justified where a few aircraft are involved and transient operations are not heavy.

The influx of high density helicopter inventories at many locations resulted in crowding. Eventually, master planning system gets something done and a lovely copter complex is added, most often near the fixed wing runway. Standards for this new construction are usually met except for existing obstructions which may be permitted to continue to exist under the "Grandfather Rights" concepts. No real problem here; the family must stick together and operate.

Now comes the real world requirement for an IFR support capability. Radar, ILS, VOR or NDB adverse weather recovery and training needs are urgent. Lo and behold, the heliport occupies the location needed for best siting of the radar antenna. Any other position will result in unacceptable high minimums, require a tower structure for the antenna, itself an obstruction, or a disrupted signal due to parked aircraft or line of sight ground traffic interference. This is BAD NEWS.

USAASO Sez the good news is: USAASO is prepared to assist airfield commanders, facility engineers and aviation officers during the early think-tank days in facility expansion planning. This service can help avoid the pitfalls of spending much money to place obstructions where they shouldn't be, if an efficient IFR facility is developed. Use USAASO during planning for updating. Use the savings for other purposes. This engineering service is also available to Army National Guard units. U-R-US-TOO.

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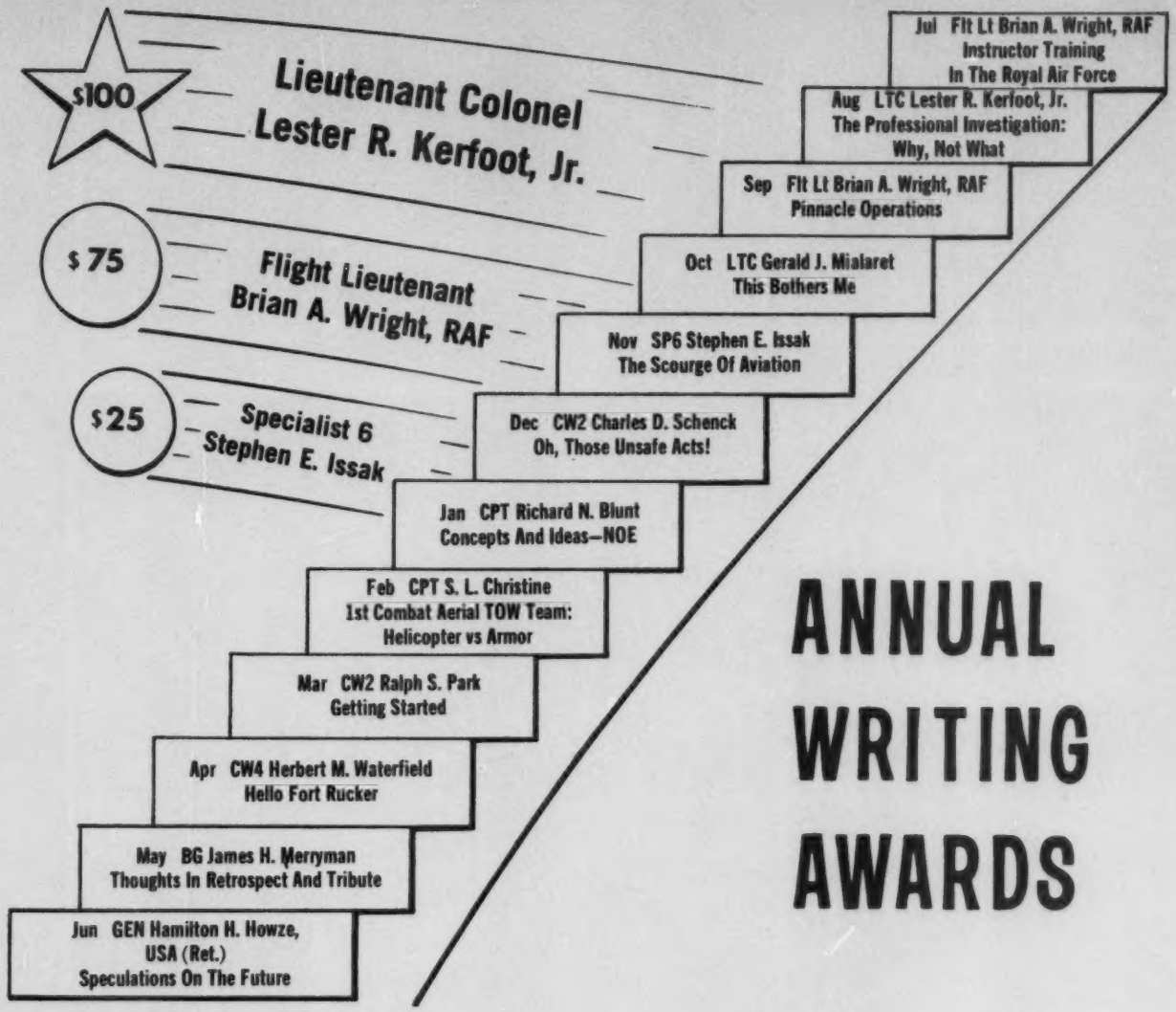

YOU COULD BE a winner if you submit an article to the AVIATION DIGEST's fourteenth annual writing contest beginning this month. The first place monthly winner will receive a certificate plus a $25.00 U. S. Savings Bond. The DIGEST also recognizes a second place monthly winner who will be awarded a certificate. A person who does not place first or second will receive credit in his 201 file plus a certificate signifying that he has had an article published in the DIGEST. Three annual award winners will be selected from the monthly first place winners. The best of the year will receive a bronze plaque plus a $100 Savings Bond. Second place receives a $75.00 bond and a certificate and third place a $25.00 bond and a certificate.

To be eligible an article must be original and concern Army aviation or related subjects. Dual authored articles are not eligible for the contest, but can be selected for publication.

Winning articles are selected by judges who review the manuscripts without bylines. Selection is based on accuracy, completeness, originality, readability, soundness, substance and overall merit.

Authors should include pictures, diagrams or charts available or necessary to illustrate manuscripts. Your articles should be submitted to: Editor, U. S. ARMY AVIATION DIGEST, P. O. Drawer P, Fort Rucker, AL 36360.

1 USAAAVS OF 12

This is the first of 12 back covers designed to show personal survival, rescue and protective equipment. Detach each cover for a bulletin board display of the more important survival and protective equipment available to crewmembers in the field.

Pearl models the fluorescent orange survival panel marker, FSN 8345-140-4232, a reflective aid in air search and rescue of downed crewmembers. The marker is lightweight, folds to a small size and is carried in the right thigh pocket of the Nomex trousers. Order your panel now through established supply channels in accordance with SB 700-50.